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OBJECT DRAWING

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PREFACE

It is a popular and fallacious conception that the ability to draw is a special heavenborn gift, whereas, in truth, with a proper understanding of underlying principles, it should be just as easy to delineate ordinary objects correctly as it is to write a sentence grammatically in longhand.

Drawing is merely another means of expression. It ought to be just as simple for any one to express his thoughts pictorially as it is for him to do so verbally or in writing. In fact, it should be easier, as pictorial representation is instinctive and naturally precedes any other mode of expression. A child, too young, not only to write but even to speak intelligibly, draws pictures of the story he has in mind, or models it in the clay with which he plays. An adult, to illustrate a point that he wishes to make clear, instinctively draws a diagram, or else, by lines that he makes in the air, describes the illustration he has not been able to picture with sufficient distinctness in words.

To observe correctly, to think clearly, to perceive relationships distinctly, that is what the study of Perspective teaches. The power to delineate generally follows as a natural consequence upon the mental development. The hand is servant to the brain and practice will train it to serve its master. Comprehension of the laws governing the science of Perspective must come first. No one's education is complete without this knowledge. Manual skill comes later. It can be acquired and is denied to few who seriously seek to achieve it.

It is not claimed that the study of Perspective and Freehand Object Drawing will create artists, any more than that the study of English Literature will produce poets and authors, but it is claimed that a knowledge of the rules underlying the subject is as much of a necessity for a well-rounded education as a knowledge of the rules of grammar or those of arithmetic. For just as a proper comprehension of grammatical rules lies at the base of all educated conversation and correspondence, and just as a thorough understanding of mathematical rules affects all

our material existence, so does our knowledge—or lack of it—of the rules governing the science of Mechanical Perspective, of Freehand Drawing, of Design, of Art in all its varied forms, affect our spiritual attitude towards life.

"The art of a people, in the same sense as its literature, is the vehicle of its profoundest feeling and highest thought."

(M. George Perrot of the French Academy.)

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List of Abbreviations

PP=Picture Plane

H=Horizon

LS=Line of Sight

LD=Line of Direction

CV=Centre of Vision

SP=Station Point

GP=Ground Plane

PL=Picture Line

DP=Distance Point

VP=Vanishing Point

CHAPTER I.

LINES AND SURFACES AND THEIR RELATIONSHIPS.

A point has position only. It has neither length, breadth, nor thickness. It is the end of a line. It is the place where two lines meet.

A dot represents a point. It is the simplest mark that can be made.

A line has only one dimension, length. It has no breadth or thickness. It is the path of a moving point. Take a wire and push it into a snowbank. The place where it enters will be marked by the end of the wire. Drag the wire along the snowbank and a line will be marked on the snow.

A line is the edge where two surfaces meet. It is not a real thing. It does not exist apart from the object to which it belongs. A spiderweb is composed of such exceedingly fine threads that they are almost invisible, yet we know that these are realities and not abstract lines, because, fine as they are, they have breadth and thickness. If we took an immense number and put them together they would form a fine rope which could be weighed.

There are two kinds of lines, straight and curved.

POSITION of lines:

1.—INDEPENDENT—when considered alone, without regard to anything else.

a.—Horizontal
b.—Vertical
c.—Oblique

2.—RELATIVE—when considered in relation to other lines or surfaces.

d.—Parallel
e.—At an angle

1. a—A LINE IS HORIZONTAL when it lies parallel to the surface of still water, pointing in any direction. It is a line lying down flat. Take a tumbler half full of water. Place several matches or tiny sticks on the surface of the water. Each one will be in a horizontal position. When the tumbler is very slowly tipped, the water, with the sticks on it, will always remain in a horizontal position.

b—A LINE IS VERTICAL when it is parallel to a plumb line. It is a line standing up straight and is always at right angles to the surface of still water.

c—A LINE IS OBLIQUE when it is neither horizontal nor vertical. It is a line that is leaning over away from the vertical towards the horizontal.

(Note—A line lying parallel to the surface of still water is always horizontal. A line on a vertical surface may be vertical, horizontal, or oblique.)

2. d—LINES ARE PARALLEL when they are equidistant, that is, having the same distance between them throughout their length.

Vertical lines are parallel only to vertical lines.

Horizontal lines are parallel only to some horizontal lines, never to vertical or oblique lines.

Oblique lines are parallel only to some oblique lines, never to vertical or horizontal lines.

e—LINES ARE AT AN ANGLE when they are not parallel to each other. That is, they would touch each other if one or both were extended. When two lines meet, or would meet if extended, so as to form a right angle or square corner, they are perpendicular to each other.

Vertical and horizontal lines are always perpendicular to each other but lines do not have to be vertical and horizontal in order to form an angle of 90 degrees. An oblique line can meet another oblique line so as to form a square corner with it, consequently oblique lines can be perpendicular to each other.

Vertical lines are perpendicular only to horizontal lines. Horizontal lines are perpendicular to vertical lines and sometimes to other horizontal lines. Oblique lines are sometimes perpendicular to other oblique lines and to horizontal lines but never to vertical lines.

A surface has two dimensions only (any two).

A dot is made on a snowbank when we run a straight wire into it. A line is made when we draw the end of the wire across the snow. A surface is made when we drag the entire length of the wire down or across the snow.

If a flat piece of tin were taken and punched straight back into the snowbank, a rectangular hole having three dimensions would have been made. The snow pushed out of the hole would form a rectangular block.

It will be seen, therefore, that a point extended in any direction forms a line. A line extended in any direction forms a surface. A surface extended in any direction forms a solid.

There are two kinds of surfaces, plane or flat, and curved.

POSITION of surfaces:

1.—INDEPENDENT—When considered alone, without regard to other lines or surfaces.

a.—Horizontal

b.—Vertical

c.—Oblique

It is most important to note that, in considering the position of planes or flat surfaces, no attention must be paid to the boundary lines of such surfaces. These make no difference whatever in the position of the surface itself. For instance: a rug may be oblong,

circular, elliptical, or square, but if it is lying on the floor it is horizontal. A mirror may be rectangular or circular in shape, but if it is hung flat against a wall its surface is vertical.

2.—Relative—When considered in relation to other surfaces.

d.—Parallel

e.—At an Angle

1. a—A SURFACE IS HORIZONTAL when it is parallel to the surface of still water. The boundary lines and their position with regard to the observer have nothing whatever to do with the position of the surface itself. (To test whether a surface is horizontal, a spirit level is used.)

Only horizontal lines can be drawn on a horizontal surface. No vertical or oblique lines can ever be drawn upon it.

1. b—A VERTICAL SURFACE is one parallel to a plumb line. A plumb line will lie flat against it. It is the only surface upon which a vertical line can be drawn.

It may be asked why, therefore, a line pointing directly towards the draughtsman, drawn on a sheet of paper lying in a horizontal position, is called a vertical line. The reason is that the correct position of a drawing is vertical, as on a blackboard. Consequently, lines in any drawing are spoken of as if they were made on a vertical surface. Most frequently the paper is placed on a desk or table for convenience. Whenever possible, drawing boards should be erect, or as much so as possible, on an easel, as greater freedom of execution would result from this position.

It has already been noted that vertical, horizontal, and oblique lines can be drawn on a vertical surface. The face of a clock is vertical. As the hands move around on it they assume different positions. The hour hand and the minute hand are horizontal when pointing to 9 or to 3, vertical when pointing to 12 or to 6, and oblique when pointing to the other hours.

1. c—A SURFACE IS OBLIQUE when it is neither lying flat, parallel to the surface of still water (horizontal), nor standing up straight, parallel to a plumb line (vertical).

Horizontal and oblique lines can be drawn on an oblique surface.

2. d—SURFACES ARE PARALLEL when they are equidistant—as the walls opposite each other in a quadrilateral room, or the floor and flat ceiling of a room. A circular mirror hung flat against a wall is parallel to a square mirror hanging flat against the wall opposite to it. The shape of the mirror does not affect the position of its surface. Rugs of different shapes lying on the floor are parallel to the surface of the table tops and to a flat ceiling, because all are horizontal.

Without tipping any, pile a number of different-sized books on the top of each other at different angles. The surfaces of the book covers are all parallel even though their edges or the boundary lines of their surfaces are at various angles.

It is important to note that when objects are spoken of then the

boundary lines limiting their surfaces must be considered, but it must never be forgotten that in speaking of surfaces there must be no thought whatever of the lines bounding them.

All horizontal surfaces are parallel to each other. They can never be parallel to vertical or oblique surfaces.

Vertical surfaces are sometimes parallel to other vertical surfaces. They are never parallel to horizontal or oblique surfaces.

Oblique surfaces are sometimes parallel to other oblique surfaces. They are never parallel to vertical or horizontal surfaces.

2. e—SURFACES ARE AT AN ANGLE to each other whenever they are not parallel. The ceiling and walls of rooms are at an angle to each other, so are the floor and walls. As they are always at right angles they are always perpendicular to each other. The surface of a mirror hung flat against a wall, whatever the shape of the mirror, is perpendicular to the surface of a rug lying flat on the floor, whatever may be the shape of the rug.

VERTICAL AND HORIZONTAL SURFACES ARE ALWAYS PERPENDICULAR TO EACH OTHER. Vertical and oblique surfaces are sometimes perpendicular to vertical surfaces.

OBLIQUE SURFACES ARE PERPENDICULAR TO SOME OTHER OBLIQUE SURFACES. They will be perpendicular to a vertical surface if the angle they form with it is 90 degrees.

Fig. 1

Place the edge of a rectangular card (Fig. 1) so that it would cut the face of a clock at 2 and 8. Tip it at such an angle that the square corner of another rectangular card, extending from x to o (the centre of the clock) would fit exactly from x to o and from o to 11. The rectangular card abcd will then be perpendicular to the face of the clock.

CHAPTER II.

Principles of Mechanical Drawing.

Perspective is the art of representing, on a flat surface, objects as they appear to the observer, not as they really are.

The top of a round table appears as an ellipse when viewed a short distance away, unless seen from a point directly above the table. A circular pond looks like an ellipse unless it is viewed from an aeroplane directly over it.

The difficulty in perspective drawing is to represent, upon one surface, the three dimensions of an object, its length, breadth or thickness, and its height or depth.

When an exact representation of an object is needed, giving its actual size and shape, geometric or mechanical drawing must be used because it gives both vertical and horizontal projections. That is, the exact measurements of the top or bottom of the object are projected to a horizontal surface, whilst the exact measurements of the front and side views are projected on to two vertical surfaces that are at right angles to each other, like the front and side walls of a room. The horizontal projection, or the mechanical drawing of a top or bottom view, is called the plan. The vertical projection, or the mechanical drawing of front or side views, is called front or side elevation.

When an object is too large to be represented actual size in the mechanical drawings (working drawings as they are called) then it is drawn to scale, just as maps are made to scale.

The principles underlying mechanical drawing must be understood in order to understand Perspective.

The following gives a rough idea of the method by which mechanical drawings are made: Take a square of cardboard and suspend it in a horizontal position directly under a bright light but not close to the light. The shadow cast on the floor will be a square. If the cardboard, still in a horizontal position, is now held at the right or left of the light, on a level with it but not close to it, the shadow on the wall will be a horizontal line or a thin oblong.

If a curtain pole is placed in a vertical position, directly under the light, the shadow on the floor will be a small circle. When, still vertical, it is placed between the light and the wall, then its shadow will be a long narrow oblong in a vertical position. The same pole, suspended in a horizontal position under the light, will cast on the floor a shadow shaped like a long narrow oblong parallel to the pole. When the pole is suspended in a horizontal position, parallel to one side of the room between the light and the wall, its shadow will be a long narrow oblong in a horizontal position. Still keeping it horizontal, turn the pole so that it is perpendicular to the wall with its end towards the light. The shadow that it casts on the wall to which it is at right angles will be a small circle.

A mechanical drawing of an object is made the same way that a

shadow is projected on to a floor or a wall. The measurements of the top or bottom are projected to a horizontal surface, whilst the measurements of the front and side are projected on to vertical surfaces parallel, respectively, to the front and side of the object.

It is most important to note that THE HORIZONTAL AND VERTICAL PROJECTIONS OF THE SAME POINT MUST ALWAYS BE DIRECTLY ONE ABOVE THE OTHER.

To illustrate more exactly the principle of mechanical drawing it is necessary to have:

1—a piece of stiff paper or thin cardboard (about 5 ins. by 8 ins.) folded across the centre. Better still is to have the corner of a cardboard box, the bottom about 4 ins. square with the two adjacent sides about the same size, though in most of the following examples only top and front views are necessary.

2—a few small straight sticks (burnt matches will do).

3—several small cardboard forms: square, oblong, triangle, circle, etc. (longest side or diameter 2 to 2½ ins.)

4—a rectangular pill box or safety match box.

5—a circular pill box.

Always keep the stiff paper with one side in a vertical position facing the observer, and the side bent towards him horizontal so as to be at right angles to the other.

Hold the match a little above the horizontal plane and a short distance from the vertical one. Let it be parallel to the horizontal or base line where the paper is folded, it will then be parallel to the vertical plane also. Trace in the air imaginary lines from each end of the match and perpendicular to both surfaces of the paper. Place a dot at each place where the pencil touches the paper, then connect these dots. Now open out the paper and the drawing will appear as in Fig. 3.

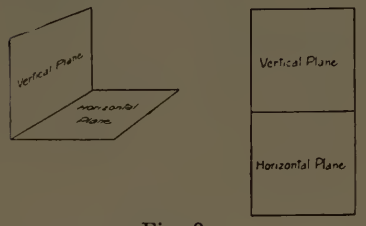


Fig. 2

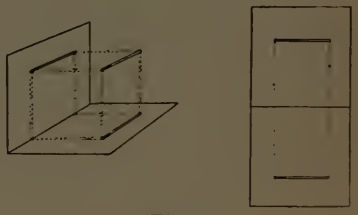


Fig. 3

Hold the match in a vertical position, as in Fig. 4 and project (with a pencil, tracing lines in the air as before), the imaginary lines from its extremities to the two surfaces of the paper, or to the two planes of projection, as they are called. It will be seen when the paper is opened out that the vertical projection or elevation is a vertical oblong the same size as the match, and that the horizontal projection or plan is a tiny circle the size of the end of the match. (Fig. 4)

Hold the match parallel to the horizontal plane and perpendicular to the vertical plane. (Note how it could be held parallel to the

horizontal plane in a number of positions and *not* be perpendicular to the vertical plane.) The projections will be seen as in Fig. 4, a tiny circle on the vertical plane and an oblong the size of the match on the horizontal plane.

From the above examples it will be seen that:

I. When a straight line is parallel to either the vertical or the horizontal plane of projection, the projection of the line on that plane will be an exact representation of the line itself.

II. When a straight line is perpendicular to either plane of projection, the projection of the line on that plane will be a dot.

III. When a straight line is neither parallel nor perpendicular to either of the two planes of projection, but is inclined towards one of them, its projection on that plane will be a foreshortened line (one shorter than the line itself).

Hold the match so that it is inclined to one or both planes of projection. Project a line from each end of the match perpendicular to both planes of projection and there make a dot. Connect these dots. Open out the folded paper and it will be seen that in each case where the match was at an angle to the plane of projection it will be represented on that plane by a thin oblong shorter than the match in an oblique position. Fig. 5.

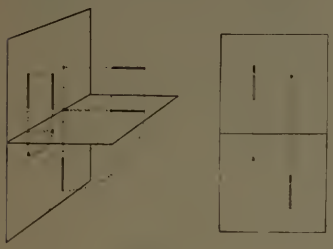


Fig. 4

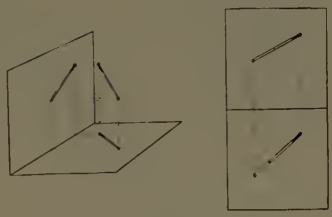


Fig. 5

Experiment with the square and circular pieces of cardboard and note that whenever either is parallel to the vertical or horizontal plane, the projection of it on that plane will be an exact representation of it. Figs. 6-7-14-15.

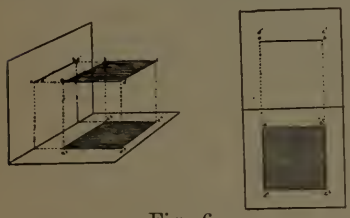


Fig. 6

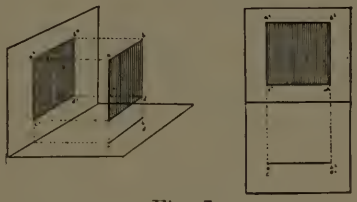


Fig. 7

When the square or circle is perpendicular to both the vertical and horizontal planes, its projection in each case will be a straight line. It

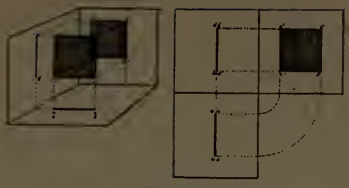


Fig. 8

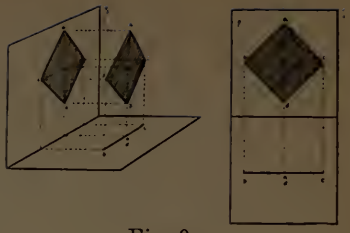


Fig. 9

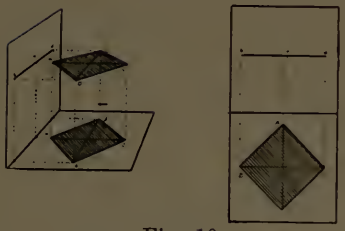


Fig. 10

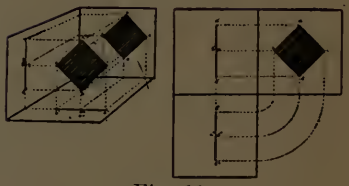


Fig. 11

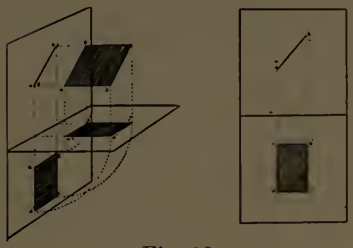


Fig. 12

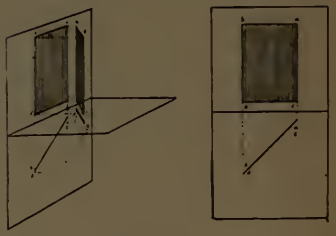


Fig. 13

will, therefore, be necessary to have a third or side view in order to show the true shape of the surface projected. Figs. 8-11-16.

Turn the square cornerwise so that it is parallel to the vertical plane, with one diagonal parallel to the hinge line between the two planes. The vertical projection will be a square turned cornerwise and the horizontal projection will be a horizontal line the length of the diagonal. Fig. 9. Reverse the position with regard to the two planes. Fig. 10.

When the square is held cornerwise so that a diagonal is perpendicular to each plane of projection, then a third view becomes necessary to show the true shape, because its projection on both the vertical and horiztonal planes is a straight line. Fig. 11.

Turn the square so that it is inclined to the horizontal plane and perpendicular to the vertical plane. In this position its inclined edges are parallel to the vertical plane, and its other two edges are parallel to the horizontal and perpendicular to the vertical plane, just as if the front edge were in the position on the hands of a clock if they pointed at the same time to the hours I and VII, II and VIII, IV and X, or V and XI. It will be found that the vertical projection

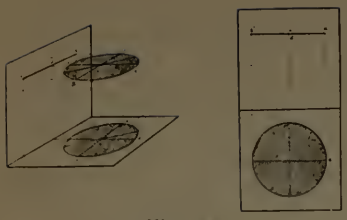


Fig. 14

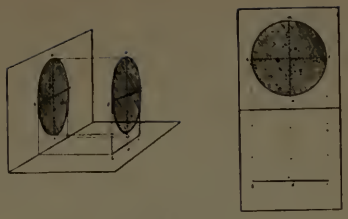


Fig. 15

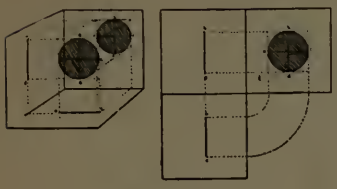


Fig. 16

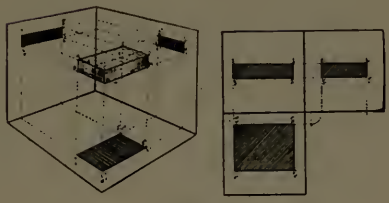


Fig. 17

of that square will be an oblique line the same length as one side of the square, and that the horizontal projection will be a rectangle but not a square. Fig. 12. Reverse the position with regard to the two planes. Fig. 13.

When the mechanical drawing of an object is to be made, showing plan, front elevation, and side elevation, two sides and the bottom of a rectangular cardboard box can be used as the planes of projection.

Hold the match box a short distance from all the three surfaces and project lines from each corner of the box perpendicular to each of the three planes of projection. If the box has been held with its longer end facing, and parallel to, the observer, the three views will be the same as shown in Fig. 17.

The mechanical drawing of the circular pill box is made in the same way as that of the match box, only, as the front and side views are the same, two projections only are necessary, the top and the front. Fig. 18.

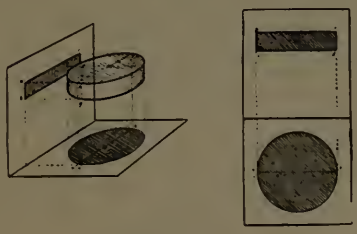


Fig. 18

It has been noted what the projection of lines will invariably be when they are parallel, perpendicular, or inclined to either the vertical or the horizontal plane of projection. It will also be seen from the above experiments in the projection of surfaces that:

IV. A plane surface, parallel to either the vertical or horizontal plane of projection, will appear its true size and shape on that plane.

V. A plane surface perpendicular to either the vertical or horizontal plane of projection will appear as a straight line on that plane.

VI. A plane surface inclined to either the vertical or the horizontal plane of projection will appear foreshortened on that plane.

That is its proportions will be altered and it will not appear its true shape.

It is exceedingly important that the six principles (three with regard to lines and three with regard to surfaces) should be thoroughly understood before starting work in freehand object drawing, because, *through a complete understanding of these, the chief difficulties of perspective drawing will be eliminated.*

Test the understanding by asking and replying to questions such as the following:

1—What is the horizontal projection of a vertical line?
2—What is the vertical projection of a vertical line?
3—What is the vertical projection of a horizontal line at right angles to the vertical plane?
4—What is the horizontal projection of a horizontal line?
5—When will a line appear foreshortened, or shorter than it actually is, on the plane of projection?
6—When will the projection of a straight line be a dot?
7—How many independent positions can a line have? Name them.
8—When the projection of a straight line on the vertical plane is a dot, what will its projection on the horizontal plane be?
9—Name the relative positions that a line can have.
10—Can an oblique line be parallel to a horizontal surface?
11—Can a square surface lie parallel to a circular surface?
12—When will a horizontal surface appear as a straight line on a plane of projection? Which plane of projection will it be?
13—On which plane of projection will a horizontal circle appear as a circle?
14—If a circle is in an oblique position, what will be the shape of its vertical projection?
15—What will be the vertical projection of a square card placed cornerwise, in a vertical position, and at right angles to the vertical plane?
16—Which vertical projection will show the longer line, that of the square named above, or that of a circular card, the diameters of the square and the circle being the same length? State the reason for your reply.
17—How must the circular card be placed so that its projection will be a horizontal line?
18—In what position with regard to a plane of projection must a square card be so that its projection on that plane will be a straight line longer than its diameter?

19—Under what condition will a surface appear its true shape on a plane of projection?

20—What is the horizontal projection of a circular card placed in an oblique position?

21—When will a square surface appear as a square on the vertical plane of projection?

22—In what position must a surface be in order to be parallel to a horizontal surface?

23—Is a vertical surface always parallel to another vertical surface?

24—Can an inclined plane be at right angles to another plane?

25—Can a plane surface in an oblique position be parallel to one that is vertical?

26—To surfaces in which two positions can an oblique plane ever be perpendicular?

27—A door is 7 ft. high, 3 ft. wide, and 2 ins. in thickness—(one-sixth ft.) In what position with regard to the vertical plane of projection must the door be in order to show the least surface? What will it measure?

28—A diamond shaped window is cut in the wall of a room. What is the position of the surface of the window with regard to the floor of the room?

29—A flat circular skylight is in the ceiling of a room. What is its position with regard to the floor of the room?

30—What are the relative positions of a plane surface and the horizontal plane of projection, for the plane surface to appear its true shape on the horizontal plane?

31—When will plane surfaces appear foreshortened on either of the planes of projection?

32—What are the relative positions of a plane surface and a plane of projection, for the surface to appear as a straight line on the plane of projection?

33—Two horizontal squares of the same dimensions, parallel to each other, one exactly over the other, are placed with one side of each parallel to the vertical plane of projection. What will the vertical projection of the two squares be and what will be their horizontal projection?

CHAPTER III.

LINEAR PERSPECTIVE — DEFINITIONS.

There are two kinds of Perspective, Aerial and Linear.

Aerial Perspective treats of the effect that atmosphere and distance have upon the appearance of objects. Linear Perspective treats of the appearance of objects as viewed from different standpoints.

Just as it is necessary to imagine the Equator and a Meridian in order to locate any place on the surface of the globe by giving its exact latitude and longitude, so is it an absolute necessity to have certain fixed standards of reference in perspective drawing, in order to determine correctly the position and shape of surfaces as an observer views them from a certain fixed standpoint. These standards of reference are:

1.—The HORIZON or EYE LEVEL—designated as H.
2.—The PICTURE PLANE—designated as PP.
3.—The LINE OF SIGHT—designated as LS.

1.—The true or natural Horizon is the line where the earth and sky seem to meet. This is not the Horizon of the art world. The Horizon in perspective drawing is the imaginary horizontal line that bounds the view on a level with the eye. Indoors, this line will be on the wall opposite the observer at the height of his eyes, or on any object cutting off his view between him and the wall. Out of doors his view will be more extended, so that his Horizon will be further off than it would be indoors. But wherever he may be, his Sensible Horizon will always be at the height of his eyes. When he is standing it will therefore be higher than when he is seated, consequently it is most important that a draughtsman should retain the same position to finish a drawing as the one in which he began it.

1.—The EYE LEVEL IS AN IMAGINARY HORIZONTAL SURFACE EXTENDING FROM THE OBSERVER'S EYES AS FAR AS HE CAN SEE. His Sensible Horizon, therefore, is the boundary line of his Eye Level.

2.—The PICTURE PLANE IS AN IMAGINARY PIECE OF GLASS PLACED IN A VERTICAL POSITION BETWEEN THE OBSERVER AND THE OBJECT TO BE DRAWN. IT IS THE VERTICAL PLANE OF PROJECTION.

Fig. 19

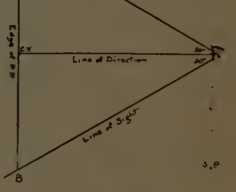


Fig. 20

The object to be drawn rests on the Ground Plane or on one parallel to it. (Note—in studio work, when the object is on a table, the Table Line,—or horizontal back edge of the supporting surface—is generally drawn a short distance behind the object.) The base of the tree trunk shown in Fig. 19 is on the same horizontal surface as S.P. It appears higher up because it is further away. To the person in Fig. 19 the LD coincides with H because both are horizontal lines on the Eye Level, but the draughtsman of the diagram, in order to show the relative positions of H and LD, has purposely drawn them as if he were a little above them.

Fig. 21

Fig. 22

Fig. 20 and Fig. 22 give the side view of PP, consequently H appears as a point. Its position is indicated by CV. Fig. 23 gives the front of PP showing H at the height of the observer's eyes. CV and L of D are not visible because the position of the observer hides them.

If an actual piece of glass is used as the PP, an exact drawing of the object or group can be traced on it. With a camel's hair brush and some Chinese white, the observer can experiment tracing the outline of one or two simple objects placed from three to five feet away. He will then see at once the absolute necessity of keeping the same position whilst drawing any object, as the appearance changes every time the observer alters his position.

a.—The piece of glass or framed net used as a PP must always be held parallel to the observer. Fig. 22.

b.—The PP is placed between the observer and the object to be drawn. Figs. 19-22.

c.—The objects to be drawn must be placed so that a horizontal line drawn from their centre to PP will be perpendicular to PP.

3.—THE LINE OF SIGHT IS AN IMAGINARY VERTICAL LINE PASSING THROUGH THE CENTRE OF VISION AND THUS CUTTING THE PP INTO RIGHT AND LEFT HALVES. In reality it is the vertical projection of the upper and lower visual rays forming the Angle of Vision whose apex is at the observer's eye. It can be considered as the front edge of a vertical plane perpendicular to PP and directly in front of the observer. It is designated as L of S or LS. Figs. 20-24-25.

NO CORRECT PERSPECTIVE DRAWING OF AN OBJECT CAN BE MADE WITHOUT FIRST CONSIDERING ITS POSITION WITH REGARD TO THE ABOVE THREE STANDARDS OF REFERENCE: the HORIZON, the PICTURE PLANE, and the LINE of SIGHT.

Fig. 23

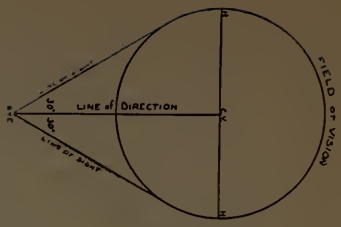


Fig. 24

The following are certain terms used in perspective drawing, with their definitions:

The point on H directly in front of the observer is called the Point of Sight or Centre of Vision. It is the vanishing point of all horizontal lines at right angles or perpendicular to PP (90 degree lines). It is designated as CV. Fig. 22.

An imaginary horizontal line, extending from the observer's eye to the Centre of Vision, is called the Line of Direction. It measures the distance that he stands from what he is delineating and also shows the direction in which he is looking. It is designated as LD. The Line of Sight, below H, coincides with LD.

A measurement, the same length as LD, set off on H at the right and left of CV, gives two points called Distance Points. These points are the vanishing points of all lines at 45 degrees to PP, that is, of all diagonals of squares. They are designated as DP1 and DP2. Figs. 21-61.

The Station Point (the eye of the observer) is at one end of the LD and CV is at the other. It shows where the observer stands. It is designated as SP. Fig. 22.

The horizontal plane, or the surface of the ground, that extends from where the observer stands to H, is called the Ground Plane, designated as GP. Fig. 22.

The horizontal line where the bottom edge of PP touches GP is called the Picture Line, designated as PL. Fig. 19-21-23.

The Field of Vision is the circular space within which objects are clearly discernible to the observer. Although objects to his right and left are visible to him, if placed too far at the side, too high up, or too low down, they are not clearly defined. Just as with the lens of a camera, so with the lens of the eye, objects must be placed within the observer's range of vision to be in focus and thus to be seen distinctly by him.

If a paper cone is made, its apex being an angle of 60 degrees, and is then truncated far enough from the apex for the observer to look through with both eyes, he will find his exact range of clear vision —30 degrees above H, 30 degrees below it, 30 degrees to the right of L of S, and 30 degrees to the left of it. The circle at the base of the cone is the Field of Vision. The 60 degree angle which forms the apex of the cone is the Visual Angle or the Angle of Vision. Figs. 24-25.

To make a true perspective drawing of objects, they must be placed within the observer's Angle of Vision—that is, not so far above or below H, or to the right or left of L of S, that he would have to turn his head to see any of them. The reason for this is, that whenever he turned his head, he would be obliged to turn his PP also, as it must always be between him and the object to be drawn in such position that the L of D would pierce it at right angles. Figs. 22-24-25.

Figs. 24-25-26 show that, as the sides of the angle diverge, the eye is able to see a much larger number of objects when they are some distance from him than when they are near.

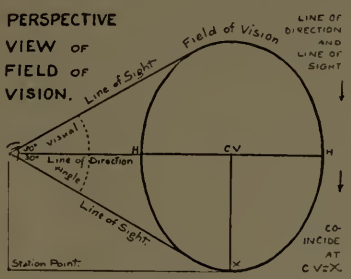


Fig. 25

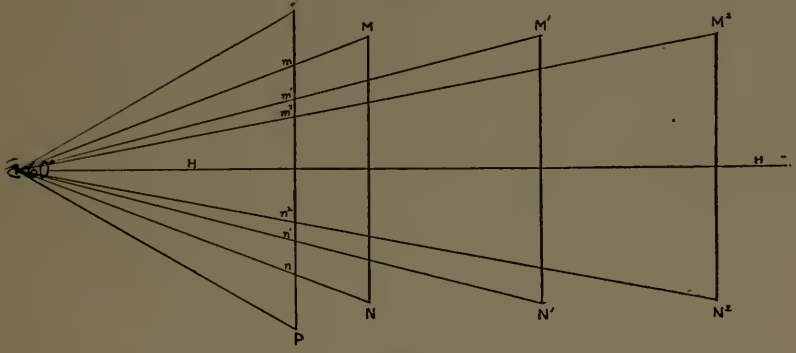


Fig. 26

The farther away an object is from the observer, the smaller it appears, as, for example, the pole MN at the three distances M N, M' N', and M" N". When the rays of light which make the pole visible come from it to the eye, their position on PP is marked as mn for the pole when nearest, m'n' when it is at M'N', and m"n" when it is at M"N". (Note 1.—When drawing an object or group of objects, the position of the draughtsman from PP should be at least one and a half times the length of the longest line in the object or group). (Note 2.—When an object is removed to a distance from the observer equal to 3000 times its own length, its size is not appreciable. It could only be represented by a dot.)

CHAPTER IV.

PRINCIPLES OF PERSPECTIVE.

When a piece of glass is not available as PP, practice with a card with a rectangular hole cut in it, about 5 ins. by 7 ins. When held up, about 8 ins. from the eye, between the observer and the object, it is easy to test relative positions just the same as if glass filled the frame.

The following experiments can be tried:

1.—Hold the pencil horizontal and parallel to PP. It will appear its true shape, even if held above or below the observer's H or to the right or left of his LS, so long as it is held *within* the observer's Angle of Vision.

2.—Hold the pencil horizontal, perpendicular to PP. Whether above, on, or below H, whether to the right, left, or on LS, its appearance will be changed from the real one. It will be foreshortened. From our practice in the projection of lines in mechanical drawing, we know that this foreshortened appearance is because the pencil is at an angle to PP.

3.—Hold a rectangular card in a horizontal position below H, with its front edge parallel to PP. Trace the outline of the card on PP. Note that the back edge of the card appears higher up than the front edge and that it also appears shorter than the front. This difference in the apparent length of the front and back edges shows that the two side edges, which are perpendicular to PP, must be approaching each other (converging). Fig. 31.

4.—Hold the card in a horizontal position with a corner nearest PP. Note that *all* the edges of the card are foreshortened because all of them are at an angle to PP.

Practice with the rectangular card held in various positions with regard to H and to LS, as shown in Fig. 27. Note that the horizontal lines at the right and left of CV are longer than the central horizontal line. That is because the right-hand side of the left square, and the left-hand side of the right square, show in addition to the front edge. The central square shows the front edge only.

In Fig. 28, with the card held in a vertical position, the vertical lines on LS, above and below H, are longer than the one in the centre with H passing through it, because the bottom line of the top square and the top line of the bottom square are shown in addition to the vertical edge parallel to PP. The central square shows the front vertical edge only.

Hold the circular piece of card in a horizontal or a vertical position perpendicular to PP and note its appearance. Fig. 29-30.

Using thumb and first finger held to the eye as a spy-glass, look through at the head of a person some short distance away. Compare its size with that of the head of some person nearby. If the observer has first been asked to estimate the size and to illustrate, in some way, his estimate, he will be surprised to find how much larger he

Fig. 27

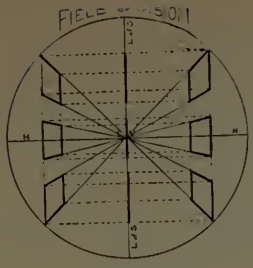


Fig. 28

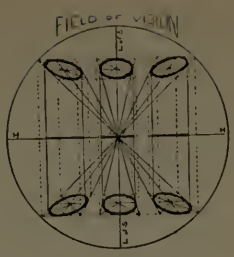


Fig. 29

believed the head to be than it appears when the distant measurements are taken.

Look out of a window, standing directly in front of it, not on one side. Trace on the pane with a pencil, the outline of windows and doors of nearby houses. Then note that the drawing of an entire building can be traced on a small pane. This shows how distance affects the apparent size of objects. A pedestrian in the street below will appear less than an inch in height, as the tracing on the window pane will show. (There need be no marks made on the pane. Just by the act of tracing, the observer will discover how their position with regard to PP and their distance from it will affect the appearance and apparent size of objects.) Figs. 31-41.

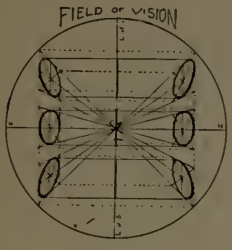


Fig. 30

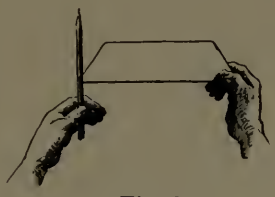


Fig. 31

As the observer will probably be in a room above the level of the street, perhaps 30, 40, or more feet, and as he can trace on the pane what is in the street below, it will be seen that the plane of the street seems to have risen. The further off that it runs into the distance from PP, the higher it will seem to rise, until, if the view is unobstructed, it will mount to the level of the observer's eye or to H. Figs. 53-58-61.

CHAPTER V.

RULES FOR LINES.

After practice in using the glass as the PP, the observer is ready for the following rules:

I. ALL LINES PARALLEL TO PP ARE TO BE DRAWN AS THEY ACTUALLY ARE, THEY ARE NEVER FORESHORTENED. THEY APPEAR SHORTER AS THEY GO INTO THE DISTANCE. (further from PP)

II. ALL LINES AT AN ANGLE TO PP ARE FORESHORTENED. That is, they are altered in appearance. (Note—A line will always be foreshortened when its position is such that it would pierce the PP if it were prolonged till it touched PP. Lines parallel to PP would always lie flat against it if brought in contact with it.)

An excellent way of showing that distance affects the size but not the shape of objects that are parallel to PP, is to hold a book, parallel, in front of a mirror, whilst some one on the opposite side of the room holds another book, exactly similar to the first, where it also can be seen in the mirror. Compare the size of the books. It will be seen that the one furthest off will look very much smaller than the one nearby. Figs. 41-53-54.

If the wall covering has a pattern, note how much smaller the reflected design from the far wall will be than the pattern immediately surrounding the mirror.

Fig. 32

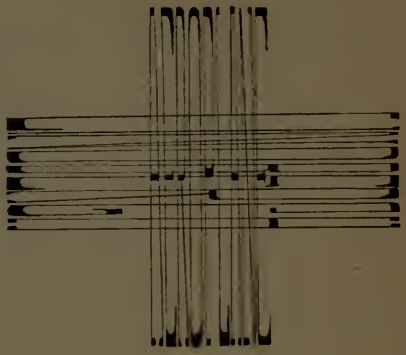


Fig. 33

III. VERTICAL LINES ARE NEVER FORESHORTENED AS THEY ARE ALWAYS PARALLEL TO PP. Fig. 58.

Those who have taken photographs of tall buildings, with the result that the structures look as if they were leaning back with their sides converging towards the top, have tipped their cameras so that the vertical lines of the buildings were *not* parallel but were at an angle to the lens of the camera which in this case became the PP.

IV. Horizontal lines may be parallel to PP or they may be at an angle. If they are at an angle they will be foreshortened and if below H will appear to come up to it, whilst if above H will appear to come down to it. Figs. 32-53.

V. Horizontal lines at right angles or perpendicular to PP meet at a point on H directly in front of the observer (the Centre of Vision). Figs. 32-53.

VI. All horizontal lines at an angle to H, except 90 degree or perpendicular lines, vanish (meet at vanishing points) on H at the right and left of the observer. Figs. 37-101.

Fig. 34

Fig. 35

Fig. 36

(Generally these points are too far off at each side of CV for both of them to be shown in the picture.)

The following exercise is a particularly good one to illustrate Rules II, IV, and V:

Sit erect. Face the front of the room. Raise both arms to a vertical position, no bend at the elbows. Point up to the ceiling. Keeping the arms in the same vertical plane, let them descend slowly, like the hands of a clock starting from XII, till the index fingers seem to touch the line of the ceiling at the right and left. Now, slowly, let the index finger of each hand trace those horizontal lines as far as they go to the front of the room. Observe two important things: 1. the horizontal lines at the right and left seem to come down—2. they seem to converge. Fig. 32.

Repeat the exercise but when the corner of the room has been reached, let the hands continue slowly to descend until they meet. They should meet, if kept in the same direction as the lines on which they started, directly in front of the observer on his Eye Level, just as they would do if the ceiling were an immensely long surface extending as far as the eye could see.

Again hold up the arms in a vertical position, with a piece of string held taut over the head, parallel to the line of the shoulders. Let the hands, still holding the string but not pulling it taut as the hands move, travel down the sides of the ceiling as before. When they reach the front corners of the room it will be seen that the string is hanging in a loose curve. This shows that the front horizontal line is shorter than the one from which the observer started and which coincided with the taut string held over his head. This is because the front line is further away from the observer's PP than the one overhead. The looseness of the string also shows that the two side horizontal lines at an angle to PP seem to converge.

Now, with the string taut, hold it so that it seems to coincide with

the horizontal ceiling line in front of the observer. Slowly bring the arms back to their original vertical position on a line with the shoulders, letting out the string as the arms travel out till it again seems to touch the right and left ceiling lines. Then note that the position of the string is the same as it was when held in front. It is still horizontal and parallel. This exercise illustrates Rule I.

Tie some small weight to the string—a key will do. Hold up this plumb line so that it will coincide with the vertical lines of the windows, doors, and corner lines of the room. It will be found that every one of the lines so examined is parallel to the plumb line. They change in length, lines of the same actual length appearing shorter as they recede from PP, but they are none of them *foreshortened* because they all are parallel to PP. This exercise illustrates Rules I and III.

Print, rather large, a word in exceedingly long narrow capitals, the height being so disproportionate to the width that it is almost impossible to read the word. Hold it in a horizontal position below the eye but very near the Eye Level. When thus held the unpleasant proportions are altered. Instead of being vertical and thus parallel to PP, the long lines are now at an angle to PP, consequently they are foreshortened, whilst the width still remains parallel to the reader and therefore unchanged in appearance. Fig. 33.

The important thing to note is that the proportions of the word, the relation that the lines bear to each other, have been altered through changing the card's position.

Attention is called to the use of the above principle in photography. If a sitter has an unusually long nose or chin, in order to make this defect less noticeable tilt the head at an angle to the camera (in this instance the PP) so that the lengthy feature will be foreshortened in the photograph.

Has the observer ever run up against a door? If so, no doubt it was open so that only the narrow edge was towards him, otherwise he would have seen it plainly and would not have come into contact with it.

VII. Lines parallel to each other and at an angle to PP meet at the same VP. Figs. 32-37-54.

The number of Vanishing Points at which the lines seem to meet

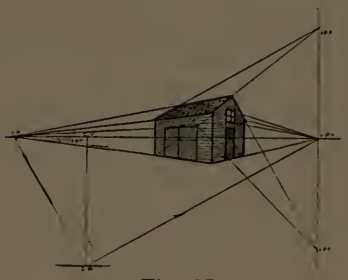


Fig. 37

Fig. 38

tells in which perspective the object is placed. For there are three kinds of Linear Perspective: Parallel, Angular, and Oblique.

In PARALLEL PERSPECTIVE, all the receding lines meet at *one* VP only, the Centre of Vision. Figs. 34-100.

In ANGULAR PERSPECTIVE, the receding lines meet at *two* VP's, both on H, one at the right and the other at the left of CV. Figs. 35-101.

In OBLIQUE PERSPECTIVE, the receding lines meet at *two or more* VP's not on H. Fig. 36-37-38.

CHAPTER VI.

RULES FOR SURFACES.

Surfaces may be in a vertical, horizontal, or oblique position.

I. VERTICAL SURFACES MAY BE PARALLEL TO PP OR THEY MAY BE AT AN ANGLE. IF THEY ARE PARALLEL THEY MUST BE REPRESENTED THEIR TRUE SHAPE, THEIR PROPORTIONS UNCHANGED. BUT IF THEY ARE AT AN ANGLE TO PP THEY ARE FORESHORTENED AND THEIR PROPORTIONS ARE ALTERED. Fig. 37-41.

In Fig. 39, the surfaces A, B, C, and D are all vertical. A plumb line would lie flat against each. (Note that it is the position of the surface which is being considered, not the position of the lines that bound it.) When the position of the object is spoken of, then the boundary lines of the surfaces must be considered. Block 3 whose front surface is C, is vertical. It is standing erect. Blocks 1 and 4, with A and D as front surfaces, are oblique because the objects are tipped. The main surface, E, of block 5 is horizontal and is therefore at an angle to PP. The narrow front surface e is vertical and therefore parallel to the observer. The surfaces A, B, C, D, and e are all parallel to PP, because, if brought in contact with PP, every part of these five surfaces would lie flat against it.

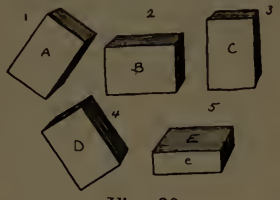


Fig. 39

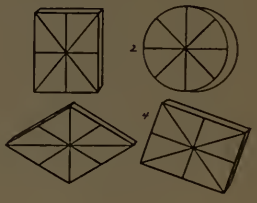


Fig. 40

The oblique position of the object, as in blocks 1 and 4, is independent of the observer or of PP. If no one were present to see it, it would still be in an oblique position. Its relative position, the one with regard to the observer or to PP, is parallel.

When a vertical surface is parallel to PP, a line in any position—vertical, horizontal, or oblique—drawn upon it is always parallel to PP or to the observer. Note the diameters and diagonals on the front vertical surfaces of Fig. 1, 2, 3, and 4. These would all lie flat against PP if brought in contact with it. Fig. 40.

II. VERTICAL SURFACES PERPENDICULAR TO THE OBSERVER AND AT HIS RIGHT APPEAR TO COME TO HIS LEFT, TOWARDS CV, AS THEY RECEDE FROM PP; WHILST THOSE AT HIS LEFT SEEM TO COME TO HIS RIGHT AS THEY GO INTO THE DISTANCE. If they extend very far they seem to disappear entirely at CV. A vertical surface at an angle of 90 degrees and directly in front of the observer, on LS, appears as a vertical line. Fig. 41.

III. Horizontal surfaces are always at an angle to PP. They are always at an angle of 90 degrees or perpendicular to it and are always foreshortened. Figs. 27-29.

The real shape of a horizontal surface is not known to the observer unless he knows its exact dimensions and so can picture it, or unless, if small, he has taken it up to look at it or has leaned over it to see it. In this latter case it was parallel to him so showing him its true shape.

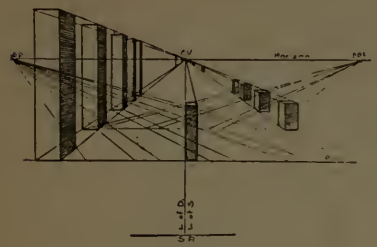


Fig. 41

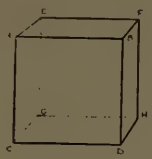


Fig. 43

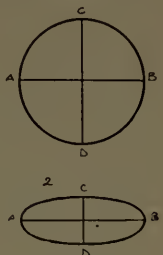


Fig. 42

A horizontal circle is foreshortened and appears as an ellipse. Fig. 42. In 1, the circle parallel, all the diameters appear their true length. In 2, the same circle lying down, the diameter AB retains its true length because its position has not been changed. It is still parallel to the observer, but the diameter CD is foreshortened because it is at an angle to his PP, consequently the proportions of the circle have been changed and it becomes an ellipse.

Fig. 43. In cube ABCDEFGH, the top surface ABEF and the left side BDFH, though both squares in reality, do not appear so because they are at an angle to PP. The front surface ABCD is a square because it is parallel to PP.

IV. Horizontal surfaces above the Eye Level, as they recede from PP, seem to come down to H, whilst those below seem to come up.

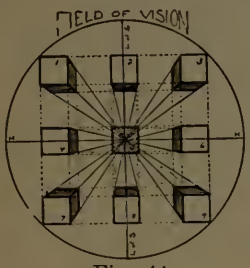


Fig. 44

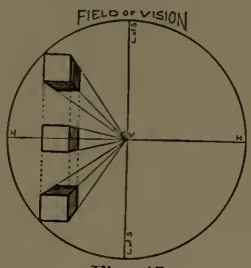


Fig. 45

The same experiment, showing that the side lines of the ceiling seem to converge until they would meet on H if they were prolonged far enough, will also show how the whole surface of the ceiling seems to descend, and the plane of the floor to rise, as they recede from PP or the observer. Figs. 32-53-58.

A horizontal surface on H, appears as a horizontal line parallel to the observer. Hold a card in a horizontal position on a level with the eyes. It will coincide with the observer's Eye Level. Figs. 27-29.

Fig. 44 shows various positions of a cube parallel to PP with the front surface showing as a square in every case because each is vertical and therefore parallel to PP.

It was previously stated that only those objects within the Visual Angle, 60 degrees, are clearly visible to the observer. The front surfaces of the nine cubes in Fig. 44 will, therefore, only be parallel to the observer if they are within his Field of Vision. Whether all nine are there, or whether there is one cube alone, the front surface of each will be parallel to PP if within the Visual Angle. Attention is particularly called to this point as it is a common error to state that, if one rectangular object by itself is at the right or left of the observer, its front surface therefore cannot be parallel to him.

All nine of the cubes in Fig. 44 are within the Field of Vision whose base is represented in the diagram by a circle. As each cube is parallel to PP, all the front surfaces must be drawn as squares and not foreshortened. Suppose that the three centre cubes and the three at the right were removed, the appearance of the three remaining cubes at the left would remain absolutely unchanged. The reason is that the *relative position of the three cubes and PP has not been altered.* So they must be drawn exactly as they were represented when all nine were shown. Fig. 45.

If, however, the three cubes had been so near to the observer that they had been outside his 60 degree range of vision, he would have had to turn his head in order to see them, and in altering his position would have had to turn PP also. In that case the front surfaces would not have been parallel to him. A corner of each cube would have been nearest PP and the square sides would have appeared as foreshortened surfaces. Figs. 46-47.

With the cubes at such close range that they are outside the 60 degree Visual Angle, the observer would have to turn to view each separately—up to the left to see 1, up to the right to see 3, down to the left to see 7, and down to the right to see 9—four distinct changes of position for his PP. Viewed thus, the cubes would have to be represented as at an angle to PP, with a corner of each nearest to

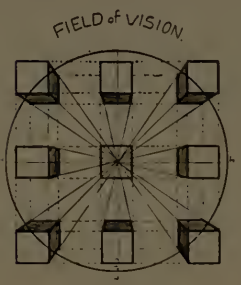


Fig. 46

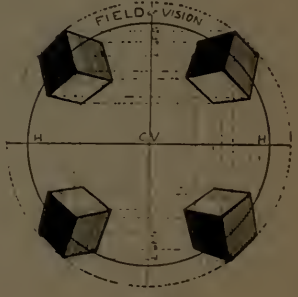


Fig. 47

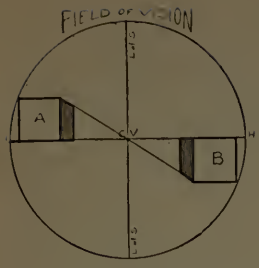


Fig. 48

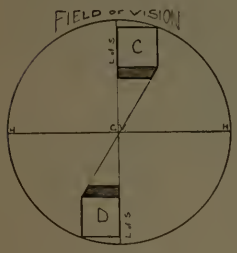


Fig. 49

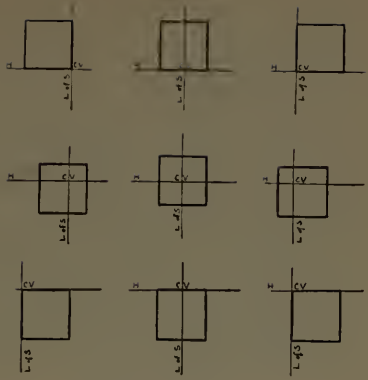


Fig. 50

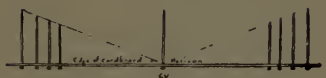


Fig. 51

it, and with none of their surfaces parallel to the observer. They would have to be drawn in Oblique Perspective, with three VP's for each cube (one for each of its three visible sides), instead of only one VP, the Centre of Vision, as with the other cubes that were parallel to PP. Fig. 44.

The size of the Angle of Vision, 60 degrees, can not be enlarged, but as the sides of the angle diverge, all that is necessary, in order that objects may be clearly visible, is to place them far enough away from the observer so that they shall be included within the diverging sides, then they will be in the observer's Field of Vision. Fig. 26.

Fig. 48 shows how a horizontal surface appears when it is on H. Whatever the shape—square, circular, triangular, etc.,—if it is on H, it will appear as a horizontal line parallel to the observer.

The cube at the left, showing front and right side, has its base on H. This base line coincides with H. Cube B at the right, shows front and left side. Its top surface touches H and is represented by a horizontal line coinciding with H.

Fig. 49 shows how a vertical surface of whatever shape—square, circular, triangular, etc.—perpendicular to PP, appears when it is exactly in front of the observer on his LS. Directly on LS it must appear as a vertical line. Cube C, above H, its front and base visible, has its left side exactly in front of the observer. The vertical line representing this coincides with LS. Cube D, below H, with its right side on LS, shows the front and the top. Its right side is represented by a vertical line coinciding with LS.

The cube will appear as a square, with no other surface than the front being visible, whenever both H and LS run through its front

Fig. 52

surface. The cube may be shifted a little to the right or to the left, or a little up or down, but it must not be moved so far as to be either entirely above or below H, or entirely to the right or left of LS. Fig. 50 shows various positions in which the cube may be shifted and yet show only one surface.

The following are two general rules:

I.—The further away an object is from the observer (PP), the nearer it is to H. Point to the base line of the wall nearest. Let the index finger travel along that line to the farthest end of the room, then notice that the floor seems to rise as it recedes from the observer. Figs. 58-78.

Fig. 53

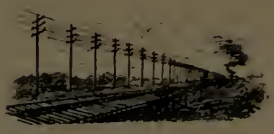


Fig. 54

Fig. 55

II.—The further away an object is from PP, the smaller it appears to be. Fig. 26-41-53-54-58.

An excellent illustration of the above rule is the following: Take several ordinary pins, all the same size. Run them up to their heads, an inch apart, in a row, so that they form a straight line. Hold up the card just on the Eye Level, with the row of pins at right angles to PP. If held at the observer's right, directly in front, or at his

left, they will appear as in the three positions shown in Fig. 51. In the central position, the row on LS, the front pin hides those behind it.

Hold a rectangular card in a horizontal position, parallel, directly in front, below H. At the same time hold a pencil in a vertical position at one of the front corners. Note that the end of the back edge of the card does not seem to touch the pencil. It appears shorter than the front edge. Fig. 31.

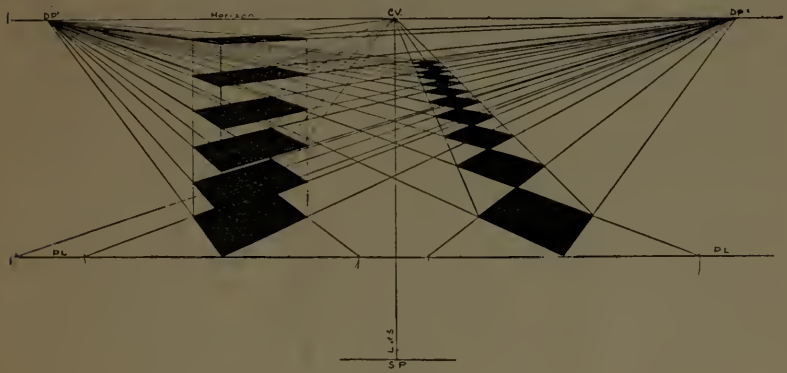


Fig. 56

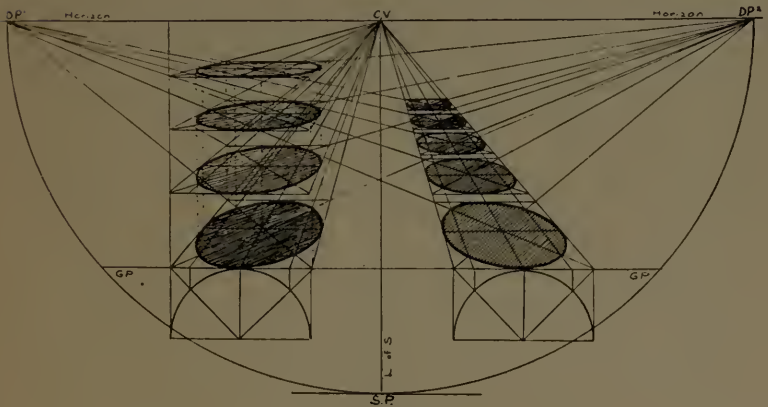


Fig. 57

Fig. 58

CHAPTER VII.

FORMULAE.

When an object is placed ready to be drawn, before putting pencil to paper, the draughtsman must ask three questions:

1. WHAT IS THE POSITION OF THE OBJECT WITH REGARD TO PP?
2. WHAT IS THE POSITION OF THE OBJECT WITH REGARD TO H?
3. WHAT IS THE POSITION OF THE OBJECT WITH REGARD TO LS?

He must have the answers to these three questions clearly in mind before he begins to draw.

To answer the first question, note what part of the object is nearest to PP—a surface, an edge, or a corner? Upon the answer to this depends the kind of Perspective in which to draw the object. If a surface is nearest then it is in Parallel Perspective. If an edge is nearest then it is in Angular Perspective. If a corner is the part nearest PP, then the object must be drawn in Oblique Perspective.

The following puts in concise form the difference that would be made in the drawing according to the kind of Perspective in which the draughtsman found the object:

1. Parallel—surface nearest—true shape—1 VP at CV (on H)
2. Angular—edge nearest—surface foreshortened—2 VP's at right and left of CV (on H)
3. Oblique—corner nearest—surface foreshortened—2 or more VP's (generally none of the VP's in Oblique Perspective are on H)

Measurements are always made at PP. In order, therefore, to decide in what Perspective to draw an object, note what part of it—(surface, edge, or corner) would first touch PP if they were in contact.

The following formula and the two variations of it should be learned as if they were algebraic formulae, the following abbreviations used in them being also memorized:

||=Parallel
<=At an angle
/=Oblique
|=Vertical
—=Horizontal
L=90 degrees or square corner

FORMULA A

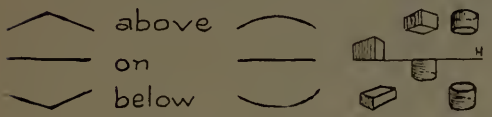
I- POSITION WITH REGARD TO PP.

surface. || - true shape 1 VP on H at CV

edge. < - foreshortened 2 VP's on H at right and left of CV

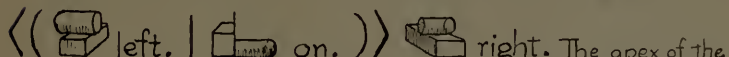
corner / - foreshorlened 2 or more VP's usually none on H

II- POSITION WITH REGARD TO H.



The apex of the angle & the centre of the curve are the parts nearest PP.

III- POSITION WITH REGARD TO LS.



The apex of the angle and the centre of the curve are the parts nearest to PP.

FORMULA B

3 POSITIONS WITH REGARD TO PP = || < /

3 POSITIONS WITH REGARD TO H =

3 POSITIONS WITH REGARD TO LS =

Lines || to each other & at < to PP meet at same VP

— lines || to each other & at < to PP meet on H at same VP

— lines at 90 degrees to PP meet on H at CV

PARALLEL PERSPECTIVE - 1 VP at centre on H at CV

ANGULAR PERSPECTIVE - 2 VP's at right & left of CV on H

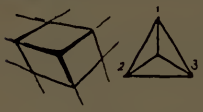
OBLIQUE PERSPECTIVE - 2 or more VPs usually all above or below H.

FORMULA C

I POSITION WITH REGARD TO PP.

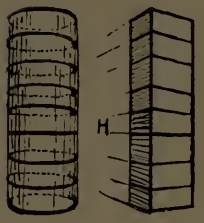
front surface nearest PP
II to PP
True shape
1 VP at CV for lines at 90 degrees to PP.

edge nearest PP
< to PP
foreshortened
2 VP's on H at right & left of CV.



corner nearest PP
< to PP
foreshortened
2 or more VP's usually none on H.

II POSITION WITH REGARD TO H.

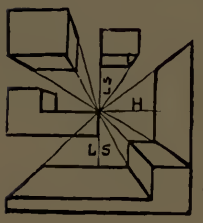


lines & surfaces in a horizontal position
< to PP
above H, run down to H.

lines & surfaces in a horizontal position
< to PP
on H, remain stationary & coincide with H.

lines & surfaces in a horizontal position
< to PP
below H, run up to H.

III POSITION WITH REGARD TO LS.



vertical surfaces perpendicular to PP
at left of LS
go to right towards LS

vertical surfaces perpendicular to PP
on LS
remain stationary & coincide with LS

vertical surfaces perpendicular to PP
at right of LS
go to left towards LS.

CHAPTER VIII.

GENERAL OBSERVATIONS.

In drawing a picture in Parallel Perspective, an artist frequently cuts off part of what is in his Field of Vision in order to render the composition more pleasing, thus leaving CV at one side of the picture. This can be understood by taking a finder (a card with an oblong hole cut in it) and laying it upon a magazine illustration of good size in Parallel Perspective. Shift the finder up and down and to the right and left, cutting off part of the picture each time, and then determine in which position of the finder the composition looks most pleasing. Fig. 52.

It might be asked, in the case of the VP being at one side of the picture, how it can be told that the picture is in Parallel Perspective and not in Angular Perspective. All that is necessary is to look at the lines not running to CV. They should be parallel to PP. If it is found that they are even at the slightest angle, then the picture is in Angular Perspective because there would be two VP's. Fig. 53-54.

When a drawing is made in Angular Perspective, unless it is made on a very small scale, generally neither of the two VP's will be in the picture. If, however, one set of lines is turned only a very little from being perpendicular to PP, then the VP of these lines will be in the drawing. Figs. 54-78.

It must be remembered, however, that however far to the right and to the left the two VP's in Angular Perspective may be, they will always be on the same level—the Eye Level. Fig. 112.

The above holds true when there are a number of rectangular objects turned at different angles. There will be two VP's for the receding lines (those at an angle to PP) of each object and there will always be CV for those lines in the group that are in Parallel Perspective. But all these VP's will be on H.

We know that every line or surface at an angle to PP is foreshortened. Nothing can be represented as it actually is unless it is parallel to PP. A horizontal line, above or below H, perpendicular to PP, and at LS, appears as a vertical line. On H, the same line would appear as a point. A horizontal surface on the Eye Level would appear as a horizontal line coinciding with H. Figs. 55-58-59.

It will help the observer to understand the following text and illustrations by remembering that the line H, cutting across PP, stands both for the front edge of his Eye Level at the PP, and also for the back edge of his Eye Level away from the PP as far as the observer can see.

A right angle when in a horizontal position is represented by an obtuse or an acute angle, as seen in Fig. 56 and 61. The front and back angles are obtuse, those at the right and left are acute.

As the rectangular surface, Fig. 56 is moved towards H, either by pushing it back on the same level (the Ground Plane), towards the distant H, or else by lifting it up or down in the same vertical plane

(the PP) until it touched the observer's H or Eye Level, the obtuse angle will flatten out. When it is lifted up or down in the same vertical plane, the rectangular surface will be equally near to PP each time. When, still at an angle to PP, it is moved back on the Ground Plane, then the nearer it gets to H the further it is from PP.

As the right angle that we are noting in Fig. 56 (the one nearest PP on the square surface) (1) recedes into the far distance, it will diminish in size as well as become flatter, until it is lost to view entirely, being too small to see. (2) As it is lifted up or down towards the observer's H, the angle will flatten out until it reaches the Eye Level, when it will have become a straight line which will coincide with H. Note that the rectangular surfaces at the left in Fig. 56 are all raised one above the other towards H in the same vertical plane, so that all the horizontal measurements parallel to PP remain unchanged, whilst those perpendicular to PP become more and more foreshortened until, at H, they become points. As the rectangular surfaces are moved back from PP, (as those at the right in Fig. 56 are) their horizontal measurements will diminish in length as their distance from PP increases, whilst at the same time their front and back angles are flattening out. When the surfaces have receded as far as the distant H, they have become too diminished in size to be seen.

Fig. 59

The same flattening takes place with curves as they approach H either when lifted up or down in the same vertical plane towards the front edge of the Eye Level, or when they are removed into the distance towards the distant H or back edge of the Eye Level.

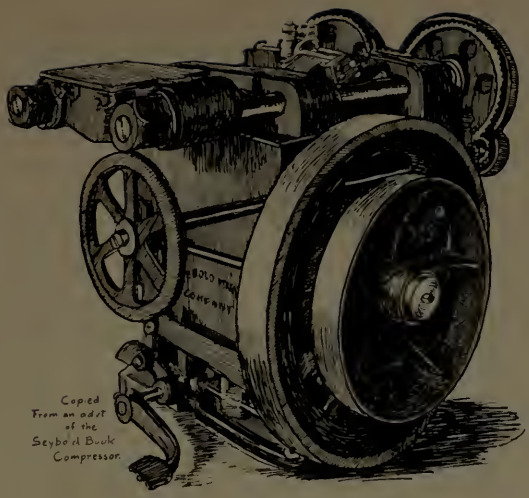


Fig. 60

In Fig. 57 the horizontal diameters, parallel to PP, remain unchanged in length as the circles approach H, but the horizontal diameters, perpendicular to PP, are foreshortened until, finally, at H they become points.

In making a drawing of a number of objects at different distances from PP, it will help beginners in perspective to remember that, with the objects above H, the one nearest the observer must be drawn highest up on the paper. With those below the observer's eye, the nearest to him must be drawn lowest down.

In Fig. 59 illustrating the above principle regarding relative distances of objects from H, objects of different heights have purposely been chosen. It will be seen that the vertical measurement has nothing to do with the distance of the objects from H. The bases only must be considered as they all rest on the same plane. In Fig. 59 the can at the left is the object nearest PP. The vase at the right is the object furthest back from PP.

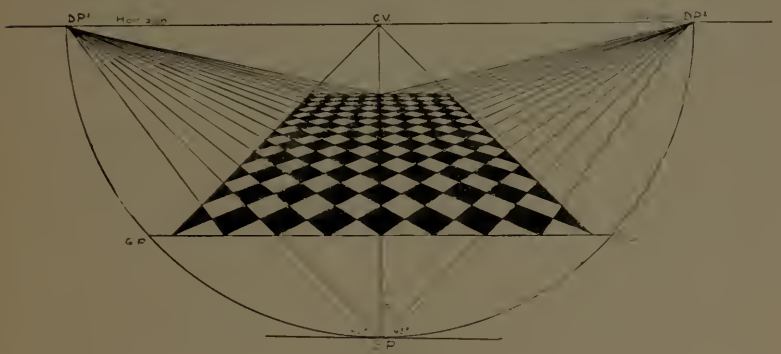


Fig. 61

CHAPTER IX.

RECTANGLES — CIRCLES.

A right angle appears as a square corner only at SP. Fig. 61. The method in Mechanical Perspective is to represent the angle its actual size at SP and to extend its sides until they reach H at VP1 and VP2. According to Rule VII: Parallel lines vanish to the same VP, therefore an angle lying anywhere on GP, whose sides vanish to VP1 and VP2 must be a right angle.

If the right angle is turned at SP so that it is cut into two equal parts by LD, then its sides will vanish on H at an angle of 45 degrees to the right and 45 degrees to the left of CV, equidistant from it. As this distance is the same length as LD, (that of the observer from PP), these 45 degree VP's are called Distance Points. As all 45 degree lines are the diagonals of squares, all lines vanishing to the Distance Points must be the diagonals of squares. Figs. 57-62.

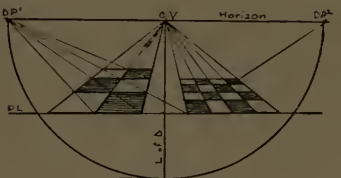


Fig. 62

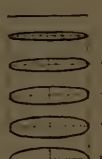


Fig. 63

Rectangular objects may be turned at any angle to PP. Fig.. 111-112-113-114. Suppose that a book is turned at an angle of 30 degrees from the horizontal at the left of the observer, then the angle at the right must be 60 degrees. Fig. 111 shows how this is represented in Mechanical Perspective. Every rectangular object whose sides vanish to the two VP's in this mechanical representation must be turned at an angle of 30 degrees to the left and 60 to the right, because only lines parallel to each other can converge at the same VP's. Objects turned at other angles than 30 and 60 degrees must have their own individual VP's.

To find the centre of any rectangle in perspective, draw the diagonals. The point where these cross is the perspective centre. The half of the rectangle lying furthest from PP is always smaller than the nearer one. Figs. 37-66.

In a horizontal square draw a circle. It will appear as an ellipse. Its perspective centre coincides with the perspective centre of the square, consequently it is nearer to the back edge of the circumference of the ellipse than to the front. Yet the ellipse is perfect in form, a line drawn through the middle of it will divide it into two parts that are identical. The diameter that is parallel to PP divides the square and the ellipse into their perspective halves. The ellipse

is tangent to the sides of the square at the ends of this line. The part of the ellipse in front of this diameter is wider than where it is tangent to the square. At this widest point the middle of the perfect ellipse will be found by drawing a horizontal line through it. Fig. 64.

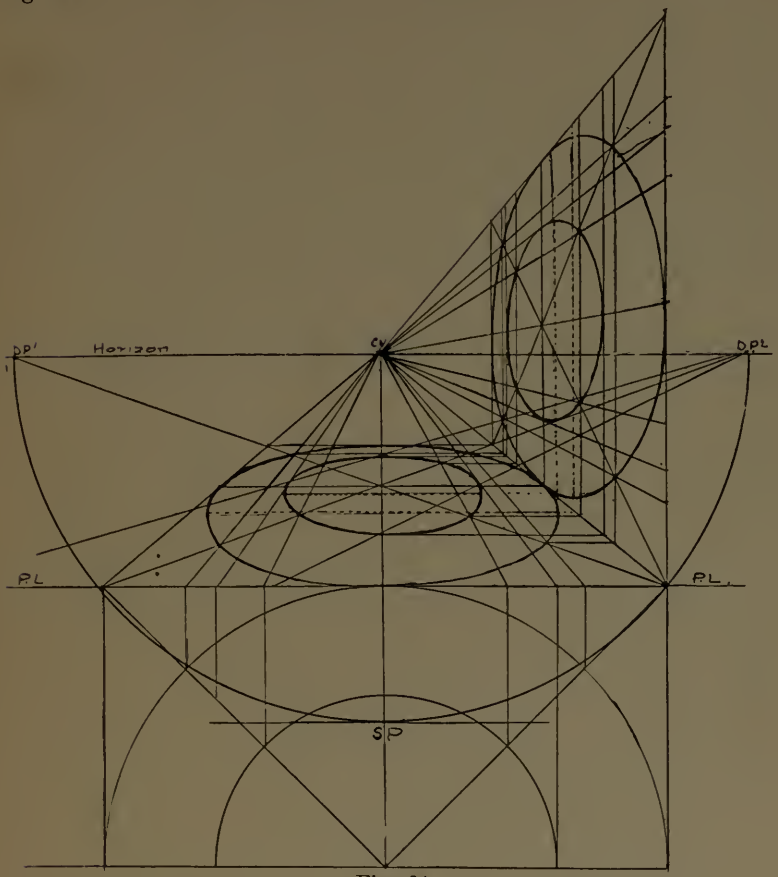


Fig. 64

When two concentric circles are perpendicular to PP, the diameter parallel to PP of the two ellipses (the two circles in perspective) will coincide as they do in the circles, but the long diameter of the two perfect ellipses (found by drawing the diameters through the wider parts that are nearest PP) will be a little apart from each other. That of the inner ellipse will be a little above that of the larger outside one if the ellipses are horizontal.

As horizontal circles (ellipses) get further away from H they widen. That is, the diameter perpendicular to PP widens. At H it is a dot. The diameter parallel to PP never changes in width.

When we draw a cylinder it is easy to remember to make the diameter (perpendicular to PP) of the ellipse furthest from H wider than that of the nearer one, but when we draw a frustum of a cone (a tumbler for instance), to make the lower ellipse wider than the upper one would be incorrect. It is the relation of the diameters as they differ in distance from H that must be considered. In Fig. 65a ab equals about $\frac{2}{3}$ of cd, a2b2 equals $\frac{5}{6}$ of c2d2 which is too exaggerated an increase in width. In Fig. 65b ab equals $\frac{2}{3}$ of cd and a2b2 equals $\frac{1}{2}$ of c2d2 which looks more pleasing and is more correct.

As horizontal circles move to the right or left of LS they seem to incline towards CV, yet in every horizontal ellipse there is always one diameter parallel to PP, and the axes of cylinders and of right cones are always perpendicular to this particular diameter. That is to say, right cylinders and cones standing up never are inclined from the vertical, even if their circular bases (ellipses when in perspective) seem to do so. Fig. 118.

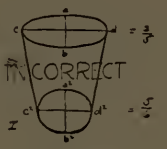


Fig. 65a

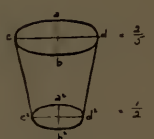


Fig. 65b

The same is true, also, of right cylinders and right cones on a shelf at an angle above H. The lines of the shelf seem to run down to H but the base of the cylinder or cone does not slope with the line of the shelf, and the axis of cylinder or cone remains vertical. Fig. 59.

When a cylinder is turned at an angle to PP, its axis will be at right angles to the longest diameter in the ellipse which forms its base (its circular base in perspective). Fig. 60.

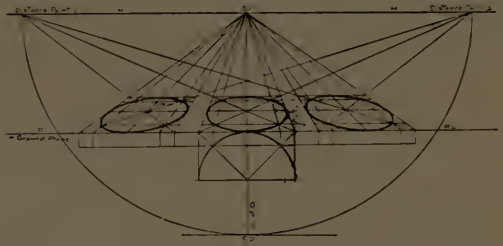


Fig. 66

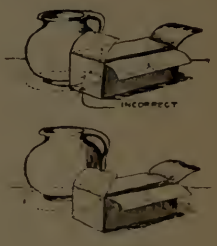


Fig. 67

CHAPTER X.

SPECIAL POINTS.

Special points, as illustrated by various diagrams throughout the text.

1.—A door (unless a swing door) can only describe a semicircle in being opened or shut. The point where the door is attached to its frame will be the centre of the circle. The ends of the diameter will be the limits to which the door can move. Figs. 78-79-81-82-92. The principle is the same for the movement of gates and shutters.

2.—In Fig. 82 the sides of each screen must all be the same width because these widths are all radii of the same or equal circles. Figs. 79-80.

3.—Bases of adjacent objects must not overlap. To avoid any overlapping, draw all the construction lines of each object as if it

Fig. 68.

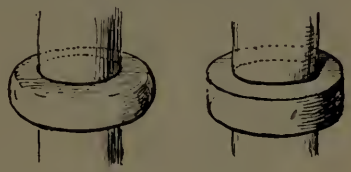


Fig. 69

Fig. 71

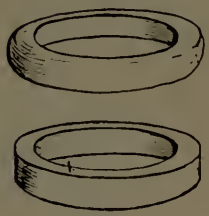


Fig. 70

Fig. 72

Fig. 73

Fig. 74

were transparent then the mistake can not be made. Figs. 59-67-68.

4.—Labels, straps, ribbons, and strings around objects are parallel to the lines of the object labeled or tied, and must be drawn according to the same rules of perspective that govern the drawing of the object. Figs. 93-94.

5.—In curved rims, both flat and rolled, the right and left sides always appear wider than in the centre because the width at the sides is parallel, so actual size, whilst the width at the centre is at an angle so is foreshortened. Figs. 69-70.

6.—In a concave surface such as a saucer, the centre will be found nearer the front than the back. With convex surfaces the reverse is true, the centre will be nearer the back than the front. Figs. 71-72.

7.—When drawing a cylindrical neck on a spherical body, as in vase forms, allowance must be made for the width of the neck. Its back curve, if drawn as though the object were transparent, must not project over the edge of the spherical surface. Fig. 73.

8.—In using curves or ornamentation on a curved surface, the inside curve must be properly related to the outside curve of the circle if the object is hollow so that all the ornamentation can be seen. Fig. 74.

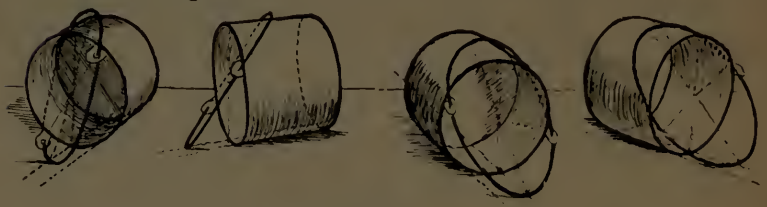


Fig. 75

9.—The lifting handle of a pail is always inserted at the ends of one of the diameters of the circle forming the top of the pail. In Fig. 75 the handle has been drawn in two positions—lying forward in front of the pail and lying back. This is done to show the curve that the handle would describe when being turned back or front whilst the pail remained stationary. Fig. 86.

When a pail is lying down with its handle turned towards PP, the point where the curve of the handle is tangent to the horizontal surface on which the pail is lying must not fall lower than the point where the pail itself is tangent to the surface.

In every ellipse, when it represents a vertical circle in perspective, there will always be two of its diameters parallel to PP, one vertical, the other horizontal. Draw the vertical diameter. The lower end of it will be the point where the pail rests on the horizontal surface. From this point of tangency draw a line parallel to the axis of the pail, extending a short distance towards PP. From the centre of the vertical diameter draw a line the same length as the depth of the curve that the handle makes. Extend it till it touches the line parallel to the pail's

axis. The point thus found will be the limit to which the handle can fall in order to touch the horizontal surface. Figs. 75-86-106.

10.—Every object in a group where the objects are turned at different angles to PP will have its own set of VP's, and all of these will be on H unless the object is in Oblique Perspective. Figs. 35-116

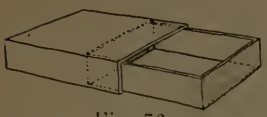


Fig. 76

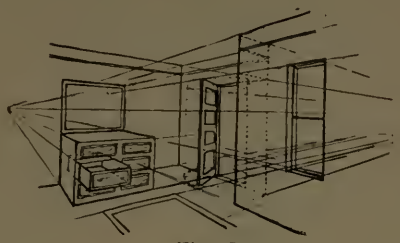


Fig. 78

11.—When a drawer is pulled out, the lines of the part extended will vanish to the same VP's as the lines of the drawer itself. The space back of the drawer must be the same length as the part of the drawer extended—that is, the length of the drawer must be the same as the space into which it fits. Figs. 76-78-95.

12.—The exterior of a building seen at an angle must be drawn in Angular Perspective, with 2 VP's. The corner of the building will be the part nearest the observer (Ordinarily speaking, a

Fig. 77

[Both an exterior angle (lower centre of illustration) and an interior angle (upper centre) in the same building are shown in Fig. 77.]

Fig. 79

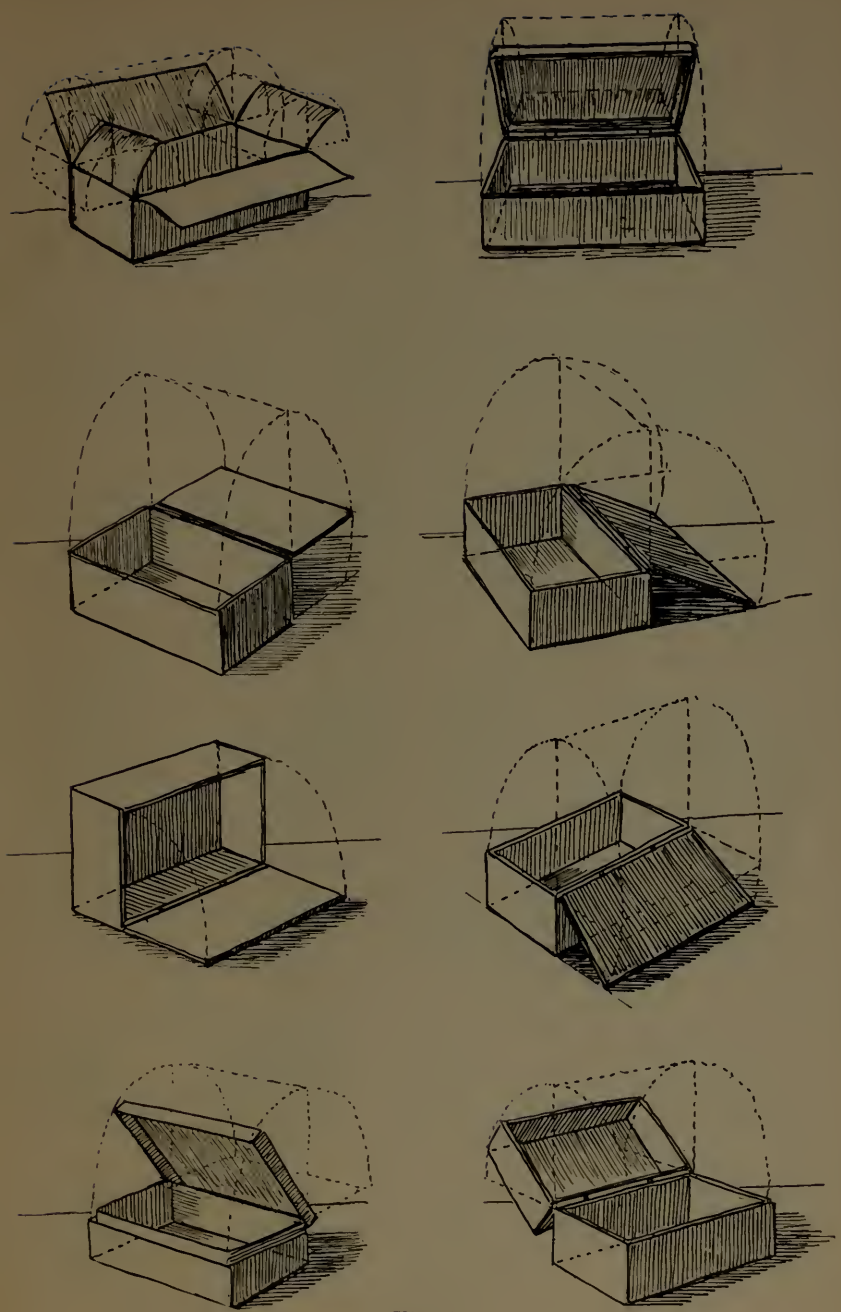


Fig. 80

corner is the edge formed by the meeting of two surfaces, as the corner of a building. A drawing of this would be in Angular Perspective with 2 VP's. Strictly speaking, a corner is the point made by the meeting of three lines or surfaces. A drawing of this would have to be in Oblique Perspective with 3 VP's.) The left lines of the corner will vanish at VP 1 at the left of CV and those of the right side will converge at VP2 at the right of CV. Fig. 37-77.

In interior views, when facing a corner, the angle of the room will be the part furthest from the observer. The lines at the two sides of the room will come towards him till they touch PP. In representing this interior, measuring always from the part nearest PP, the lines of the wall at the observer's right must vanish to VP1 at the left of CV, whilst the lines of the wall at the left must converge at VP2 at the right of CV. Fig. 77-78.

The Cylinder as the basis of construction for the opening book, lid, door, shutter, etc. is shown in Figs. 79-80-81-82.

The relation of the handle of an object to its spout is illustrated in Figs. 83-84.

Handles of various forms are shown in Figs. 85-98.

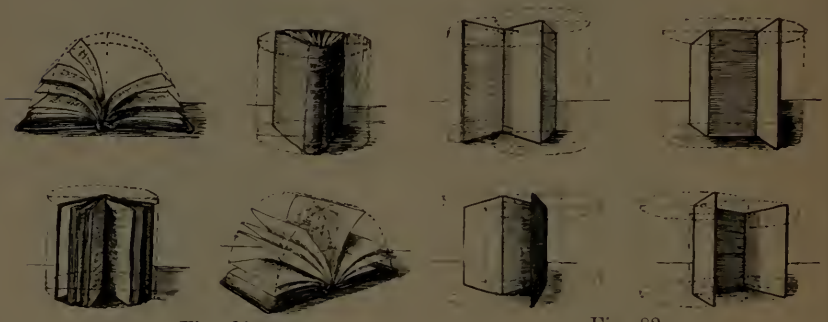


Fig. 81

Fig. 82

Fig. 83

Fig. 84

Fig. 85

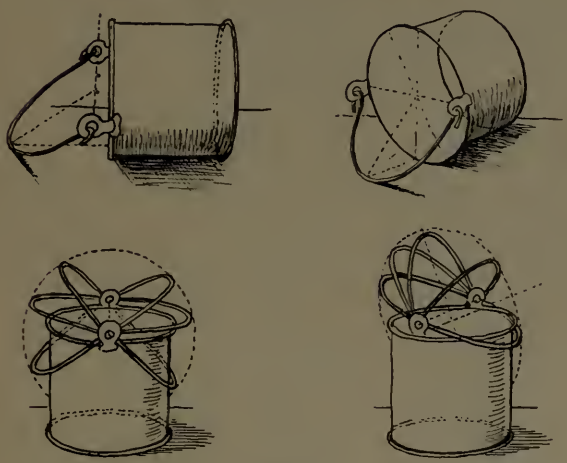


Fig. 86

CHAPTER XI.

SUGGESTIONS.

In order to obtain freedom of execution in drawing, the following hints are given:

1.—Use a rather soft pencil—medium grade as F or HB.
2.—Use a long pencil, the lead about ¼ in. long, not sharp-pointed.
3.—Hold the pencil nearer to the blunt end than to the point.
4.—Hold the pencil loosely.
5.—Hold the pencil as if it were a baton beating time in music. Do not hold it as if it were a pen used in writing. The position recommended is specially urged as it prevents hard rigid lines.
6.—Sit back, 18 or 24 inches from the drawing.
7.—Have the drawing board on an inclined surface or erect on an easel. To obtain the best results never have it horizontal.
8.—Sketch in, with a few loose, very light lines, all the principal lines of the object or group before completing any part of it.
9.—Avoid the use of the eraser.
10.—Leave in all the light trial lines until the correct ones are found. The others can then be erased and the correct lines accented. In accenting lines and completing a drawing, the pencil may be held as in writing, and nearer to the point than in sketching in the trial lines.

There are certain simple devices that will be found very helpful. They are as follows:

1.—The oblong finder, already spoken of, which can be used as a small PP.
2.—Two strips of stiff paper with which to measure angles. Fig. 87.
3.—A piece of stiff paper folded in the centre, with which to illustrate the principle of the screen, the opening door or gate, and the opening lid of a rectangular box. Figs. 88-89-90-91.

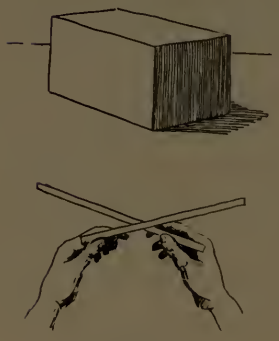


Fig. 87

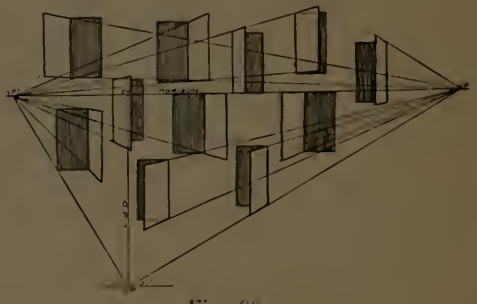


Fig. 88

4.—A piece of stiff paper with three sides of a rectangular hole cut in it, the flap being left. This will also help to illustrate the principle of the opening door, gate, or lid. Fig. 92.

5.—A piece of stiff paper with two equal rectangular holes, side by side, cut in it, the flaps may be adjacent to the strip in the centre of the paper, between the holes, or they may be at the sides. This serves to illustrate the double door or shutter. Fig. 92.

6.—A rolled piece of paper, fastened, to form a cylinder.

7.—A plumb line for testing vertical edges.

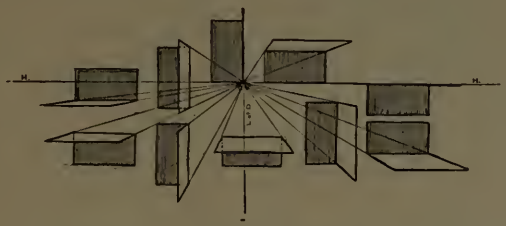


Fig. 89

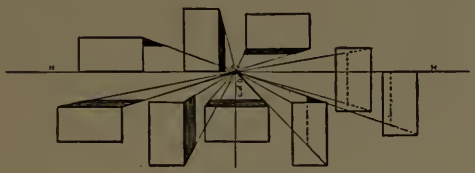


Fig. 90

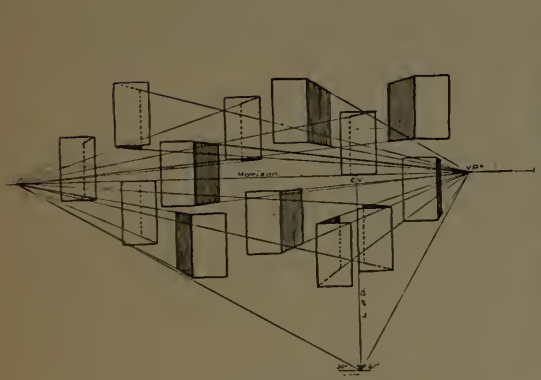


Fig. 91

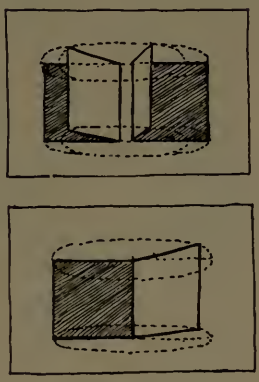


Fig. 92

CHAPTER XII.

THE TYPE SOLIDS — OBJECTS BASED ON THEIR FORMS.

Almost every object in common use is constructed on the form of some type solid, consequently it is not alone necessary to be familiar with the names and appearance of all the type solids, but it is absolutely essential to thoroughly understand the construction of each. Equipped with this knowledge, seemingly difficult problems are resolved into very simple ones. The draughtsman who knows how to draw a square surface and a cube in any position has mastered the major part of perspective, because the underlying structure of almost every object is the rectangle with the prism built upon it. The circle can not be correctly drawn in perspective without using the square as its foundation. The following are the type solids:

Plane Surfaces	Curved Surfaces
Cube	Sphere
Square Prism	Hemisphere
Rectangular Prism (oblong)	Cylinder
Square Plinth	Circular Plinth
Square Pyramid	Cone
Frustum of Square Pyramid	Frustum of Cone
Triangular Prism	Ellipsoid
Hexagonal Prism	Ovoid
Hexagonal Plinth	
Hexagonal Pyramid	
Frustum of Hexagonal Pyramid	

Pentagonal and Heptagonal (5 and 7 sided) solids are not common. Octagonal (8 sided) forms are found a little more frequently.

Objects based on the form of type solids—

Plane Surfaces

Cube—box, alphabet blocks, base of balustrade. Fig. 93.

Square Prism—box, trunk, legs of tables and chairs, etc., square posts.

Rectangular Prism—books boxes, bricks, pieces of furniture such as bureau, refrigerator, etc.* Figs. 95-97-98-99.

Square Plinth—base of column and of pedestal. Figs. 93-102.

(Prisms take their names from the shape of their bases. Cubes, square prisms, and square plinths are all rectangular prisms, all are square prisms. An oblong prism is a rectangular but not a square prism. This is the form upon which most rectangular objects are commonly based.)

Square Pyramid—steeple, hip roof, architectural finials. Figs. 93-103.

Frustum of Square Pyramid—lamp and candle shades, berry basket, metal weight, Mansard roof. Figs. 93-103.

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* Note—Figs. 100-101 are based on the form of the Rectangular Prism.

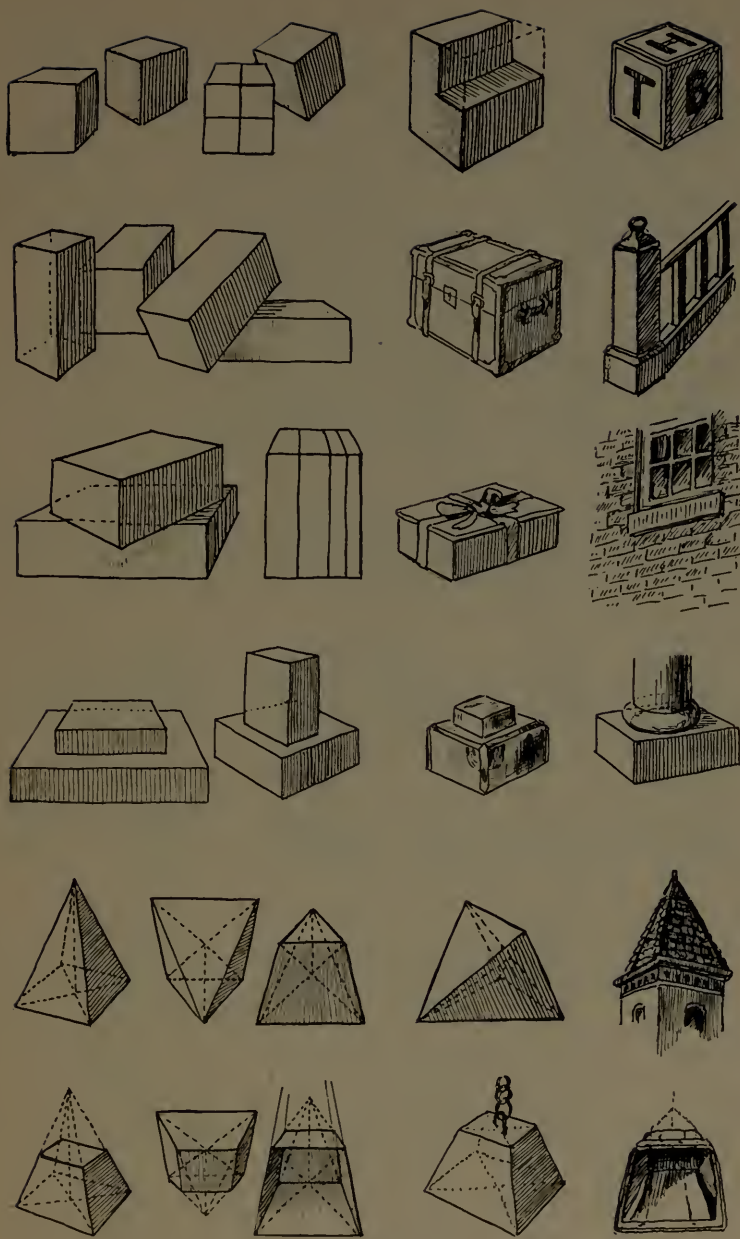

Fig. 93

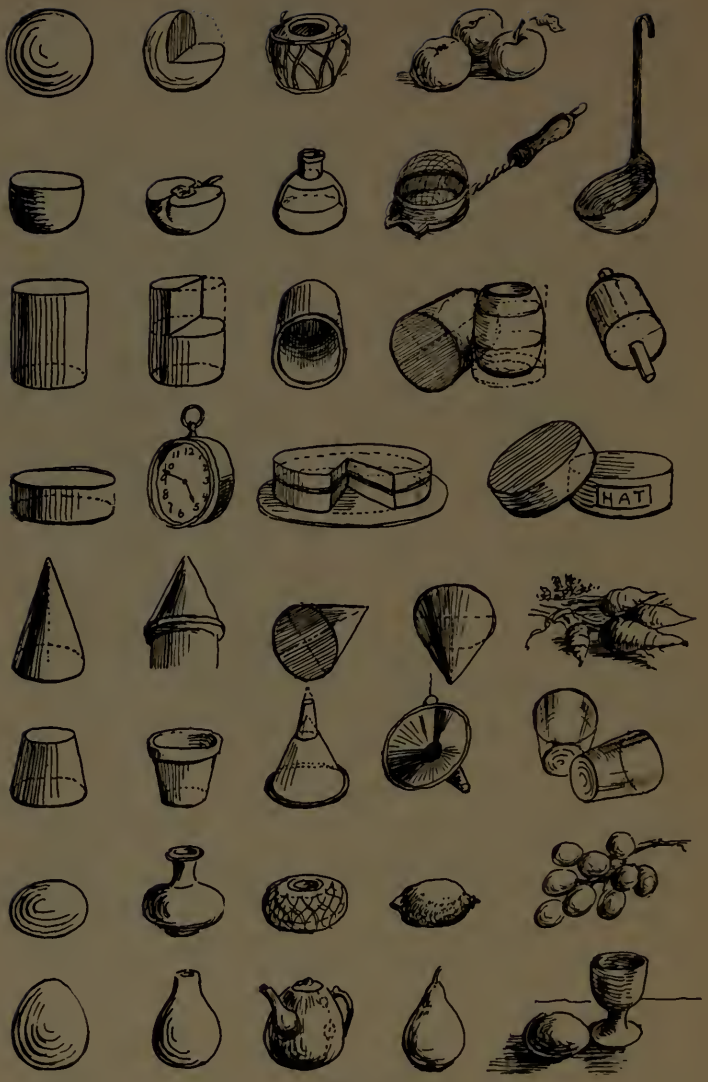

Fig. 94

Fig. 95

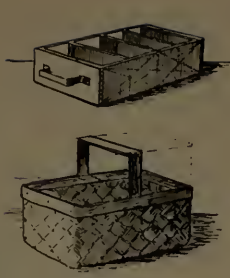

Fig. 98

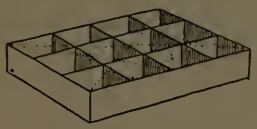

Fig. 97

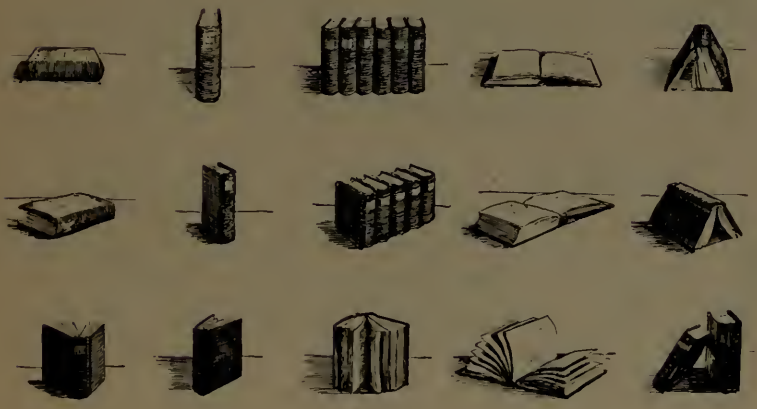

Fig. 99

Triangular Prism—chicken coop, show-case, tent, roof. Fig. 104.
Hexagonal Prism—tea canister, pencil. Fig. 105.
Hexagonal Plinth—head of a bolt. Fig. 105.
Hexagonal Pyramid—steeple, architectural finials. Fig. 105.
Frustum of Hexagonal Pyramid — card basket, lamp and candle shades. Fig. 105.

Curved surfaces:

Sphere—ball, fish globe, gas globe, globe (geography map), teapot, vases, apple, cherry, and other fruit. Fig. 94.
Hemisphere—cup, bowl, saucepan, lamp shade, Japanese lantern, dome, open umbrella. Fig. 94.
Cylinder—boiler, pipe, column, pole, tree trunk, candle, bottle, mug. Fig. 106.

Circular Plinth—hat-box, alarm clock, base of a pedestal. Fig. 94.
Cone—tent, spinning top, architectural finials, carrot, parsnip. Fig. 94.
Frustum of Cone—tumbler, flower pot, funnel, pail, lamp shade. Fig. 107.
Ellipsoid—vase, Japanese lantern, lemon, grape, and other fruit. Fig. 94.
Ovoid—egg, vase. Fig. 94.

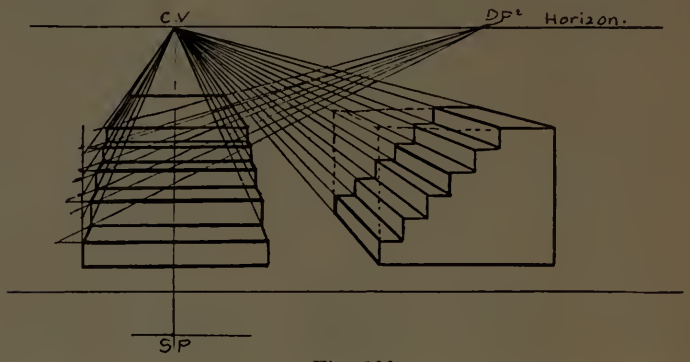

Fig. 100

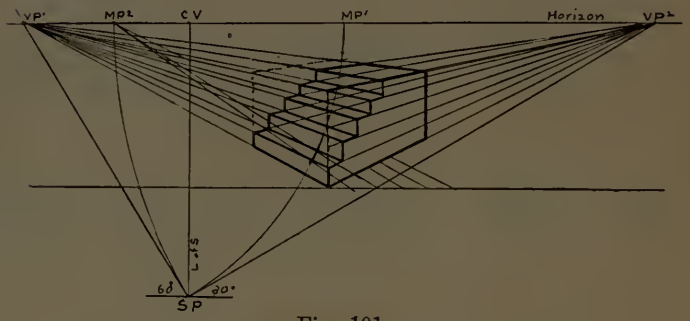

Fig. 101

Fig. 102

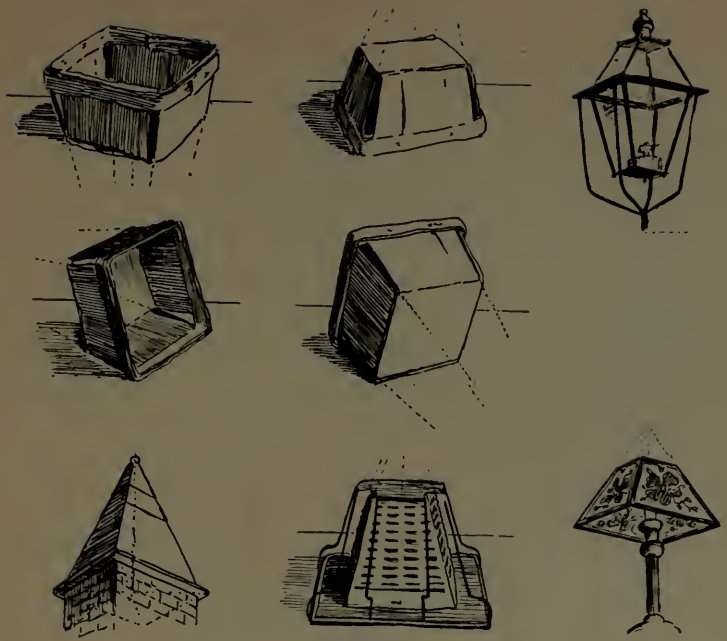

Fig. 103

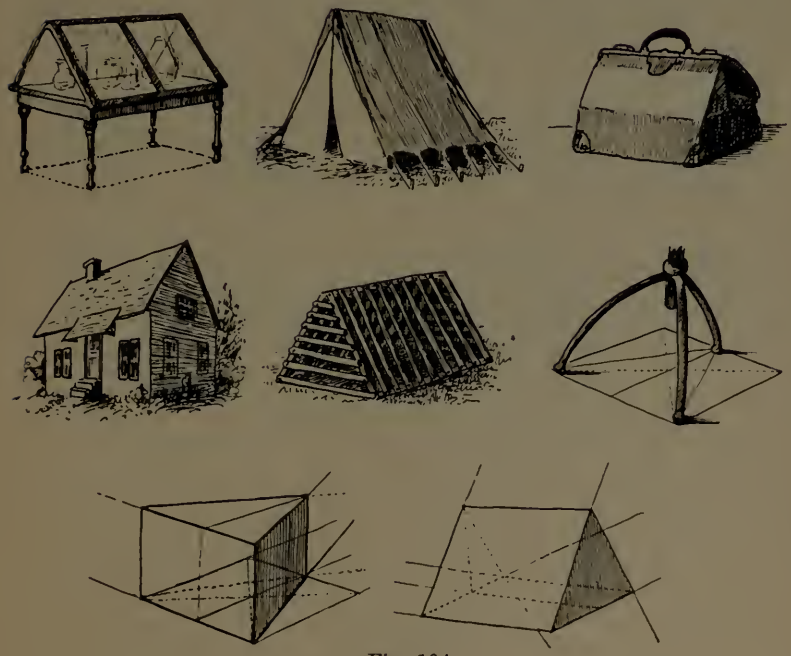

Fig. 104

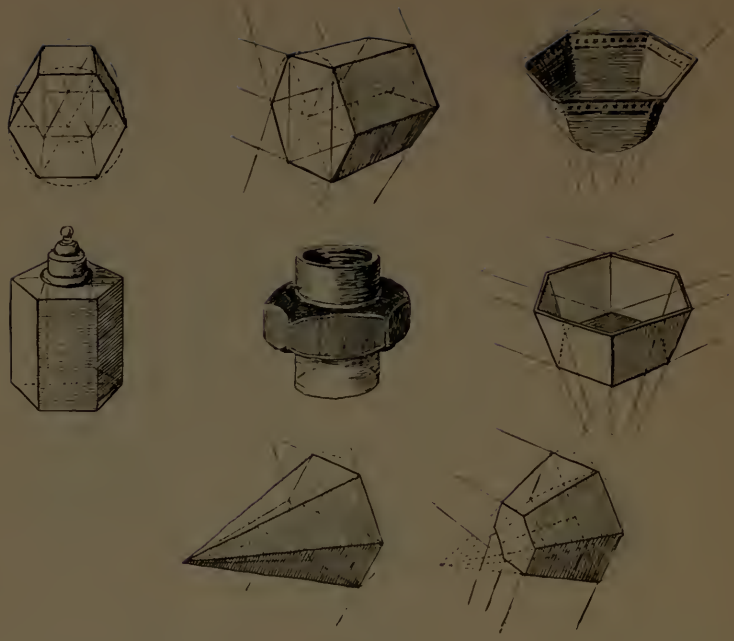

Fig. 105

Fig. 106

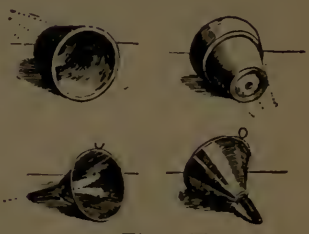

Fig. 107

CHAPTER XIII.

MECHANICAL PERSPECTIVE.

To find the distance that an object is from PP, draw a line from CV to the point of the object's base (point A) nearest to PP. Extend the line until it touches PP at point B on the Picture Line. From the DP nearest to the object, draw a line through point A and extend it until it reaches PL at point C. Fig. 108.

As DP's are the VP's of diagonals of squares, we now have two sides of a square, AB and BC. As measurements on PL are actual, ascertain the length of BC by measuring it. AB will be the same length. Fig. 62.

Fig. 108

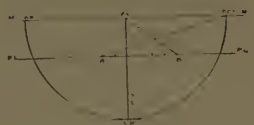

Fig. 109

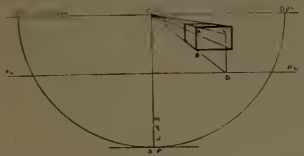

Fig. 110

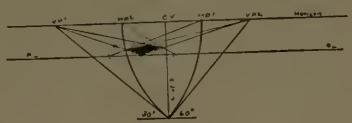

Fig. 111

Fig. 112

Fig. 113

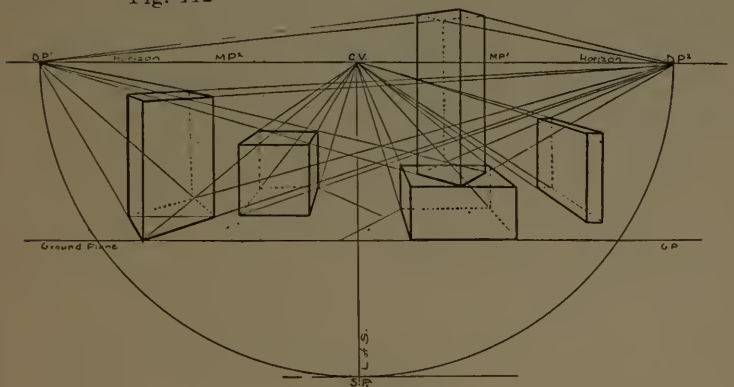

Fig. 115

DP's are the measuring points of all lines vanishing at CV (all 90 degree lines). If we wish to measure off 6 inches on a line perpendicular to PP, all we have to do is to measure off 6 inches at point B, to the right or left of the end of the line where it touches PL at A, and from that point draw a line to the nearest DP, crossing

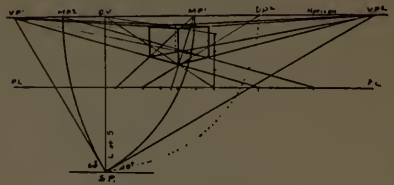

Fig. 114

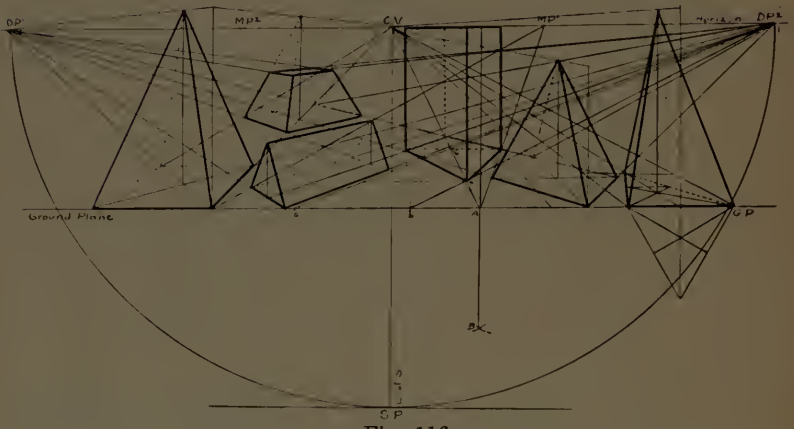

Fig. 116

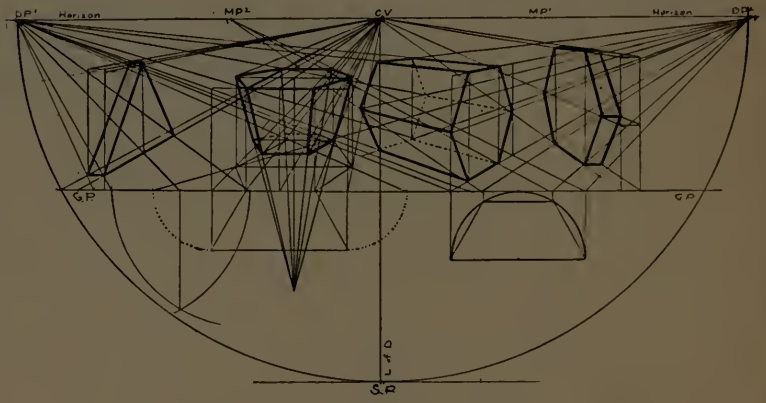

Fig. 117

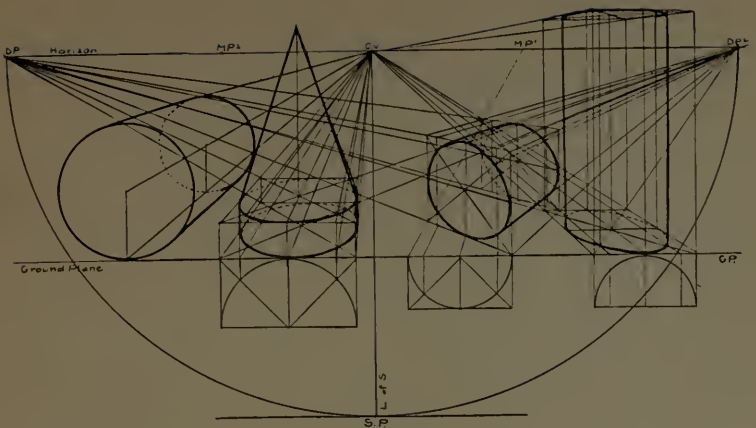

Fig. 118

the 90 degree line at C. As AB and BC are the two sides of a square they are both the same length. So BC is 6 inches, the required length. Fig. 109.

To measure the height of a distant object, draw lines from CV to its top and base (A and B in Fig. 110), and extend these lines until they reach PL at CD. Measure CD. AB is the same length because it is parallel to CD and is included between two parallel lines (Rule VII). Fig. 110.

In Angular Perspective, every VP has its own individual measuring point (MP). It is found by using each VP as the centre of a circle and the distance of that VP from SP as radius. Describe an arc from SP to H. The point where it touches H will be the MP of that VP which has been used as the centre of the circle. Fig. 111.

Each MP so found will measure on PL the length of any line vanishing to its own particular VP but none other.

Distance from PP into the picture must always be ascertained by using the line from CV to PL and cutting it off by the line from PL as described above. Fig. 109.

The position of the VP's will be determined by the position of the right angle at SP where it appears its true shape and where the angle that it makes to PP is shown. Figs. 101-111-112-113-114.